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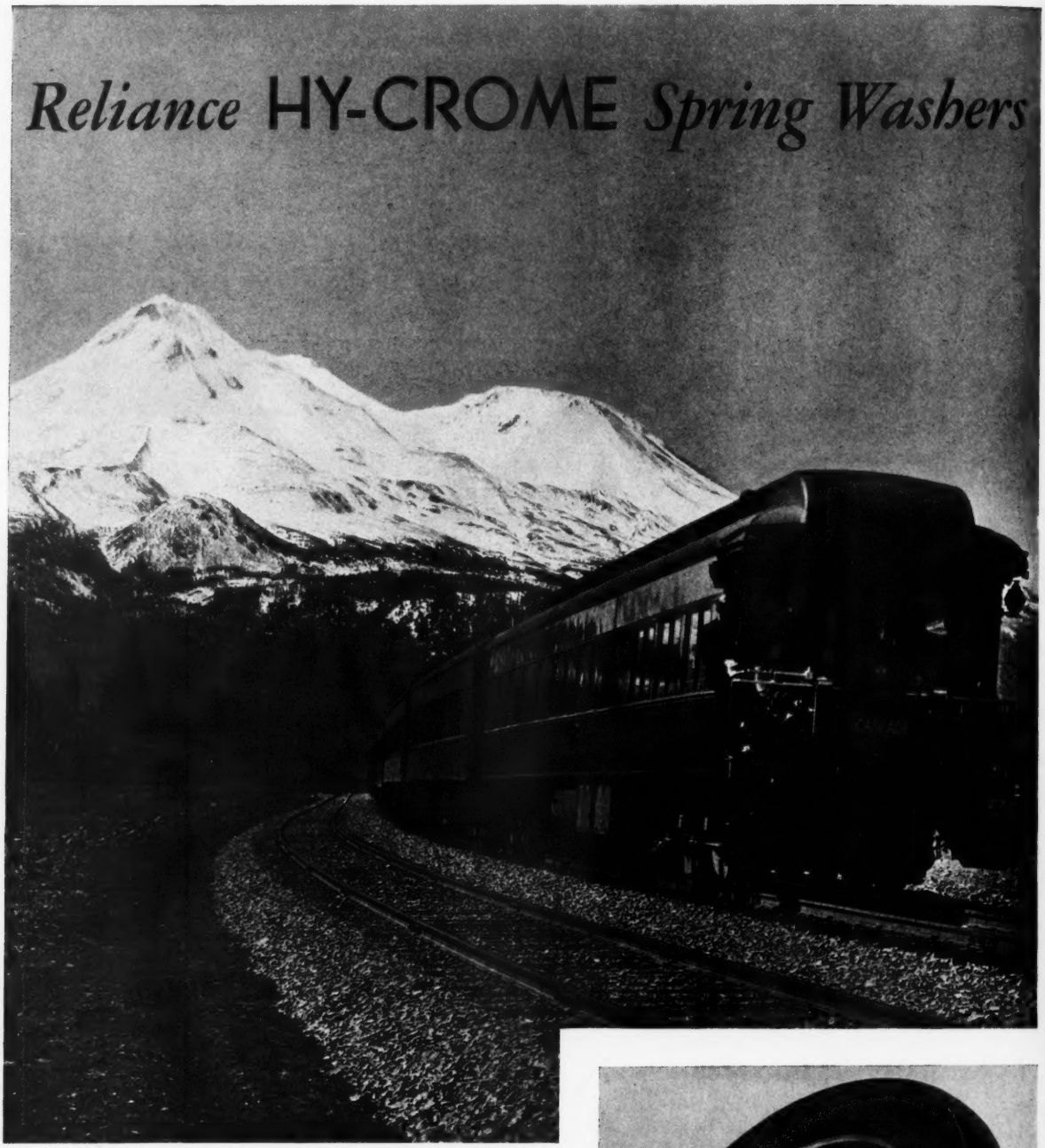

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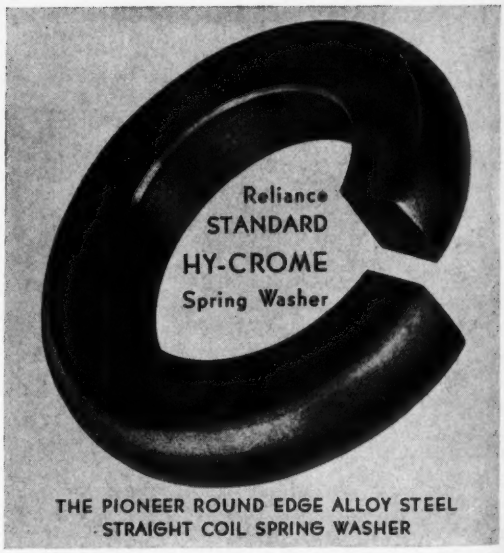

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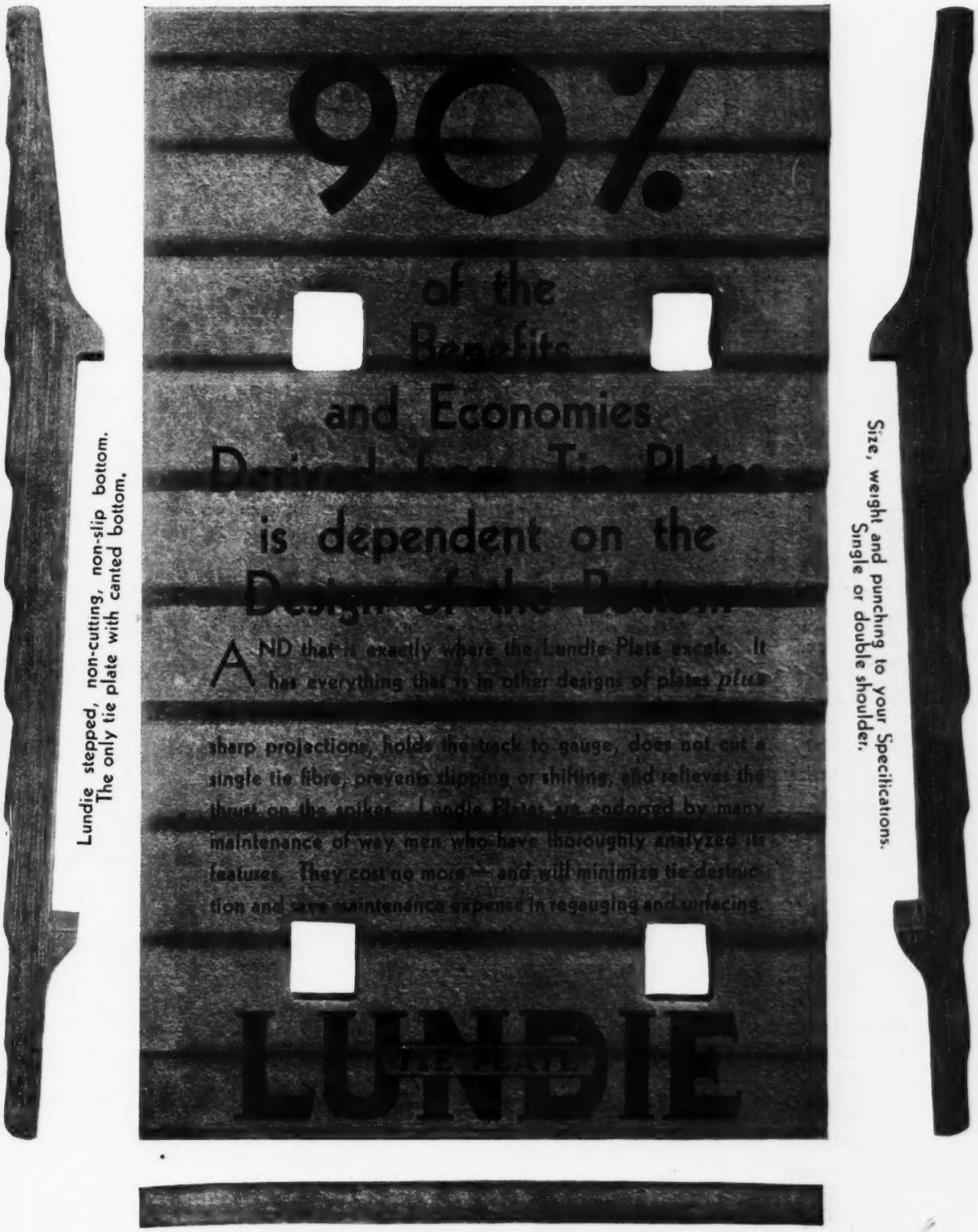
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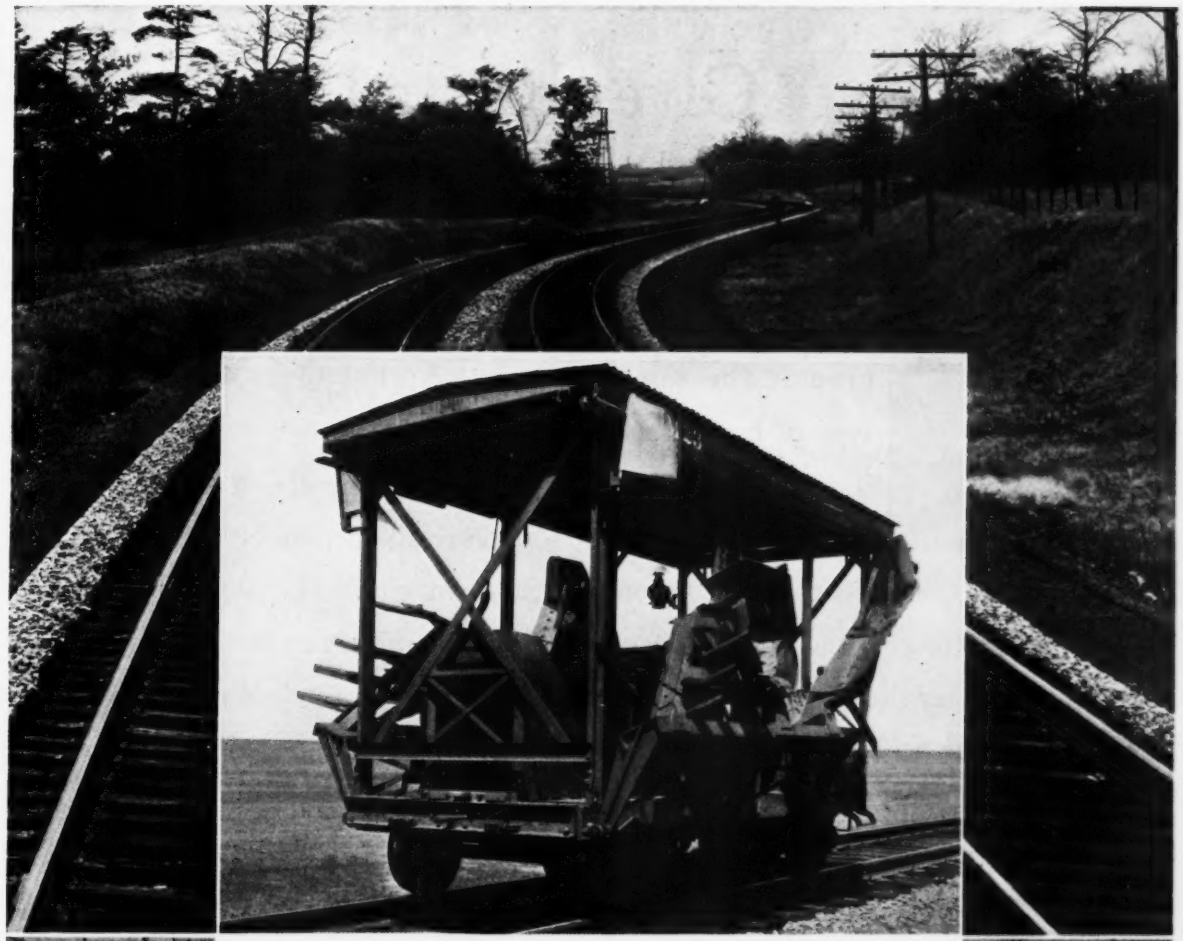

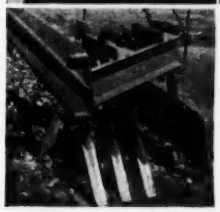

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A roadbed is only as good as its drainage structure. How that structure does its job is the factor that dictates the cost of track maintenance and the number of "slow orders" that go out.

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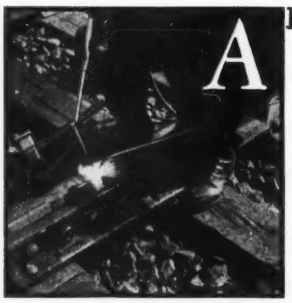

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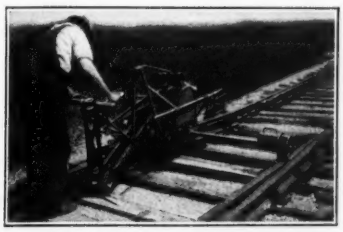
for next year's maintenance jobs



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Periodical maintenance of track bolts with speed and uniform tightness.

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For fast, accurate track raising on ballasting and surfacing jobs.

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No. 72 of a series

Railway
Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: Two Series of Articles

November 29, 1934.

Dear Reader:

In our constant study of the conditions confronting you in the conduct of your daily work, we occasionally run into problems that cannot be treated adequately within the limits of a single article. This leads to a series of articles, each contributing to the development of the subject. Such a series, published in 1928, developed a practical method for the string lining of curves. Another series, published in 1930-31, dealt with the maintenance and operation of motor cars. These two groups of articles met with such a hearty reception from you that they were both reprinted to meet the hundreds of demands for extra copies and one series is now in its second reprinting.

We now have in hand two similar series. Not a few of you have been commenting for years on the needlessly excessive cost of manufacturing track materials and track tools by reason of the many variations in designs, most of which are minor in detail but sufficient to require individual dies or patterns. I have also noted the agitation from time to time, and more frequently of late, to correct this condition by rigid standardization. I view this latter attitude with as much concern as the first and believe it an impractical approach to the desired objective. Because of this, we have made detailed investigations of the effects of these many designs in the shops of manufacturers and on the tracks, and these are set forth in a series of articles, the first of which appeared in our November issue.

Again, we learned a few months ago that a system maintenance officer had discovered that by reason of an almost complete dearth of literature on the maintenance and repair of roofs of the types found on the wide variety of railway buildings, there was a wide diversity in practice on different divisions of his railway. He set about to correct this condition, gathering material from many sources into a manual of uniform practices for the building supervisors on his road. Believing that the information so collected will be equally helpful to those of you who are confronted with this problem on other roads, we have prepared from this manual a series of nine articles on railway roofing practice, the first of which will appear in the January issue.

I hope that these efforts of ours, somewhat more ambitious than usual, may prove of interest and value to you. I shall be interested in your reaction.

Yours sincerely,

Elmer T. Howson

ETH*JC

Editor.

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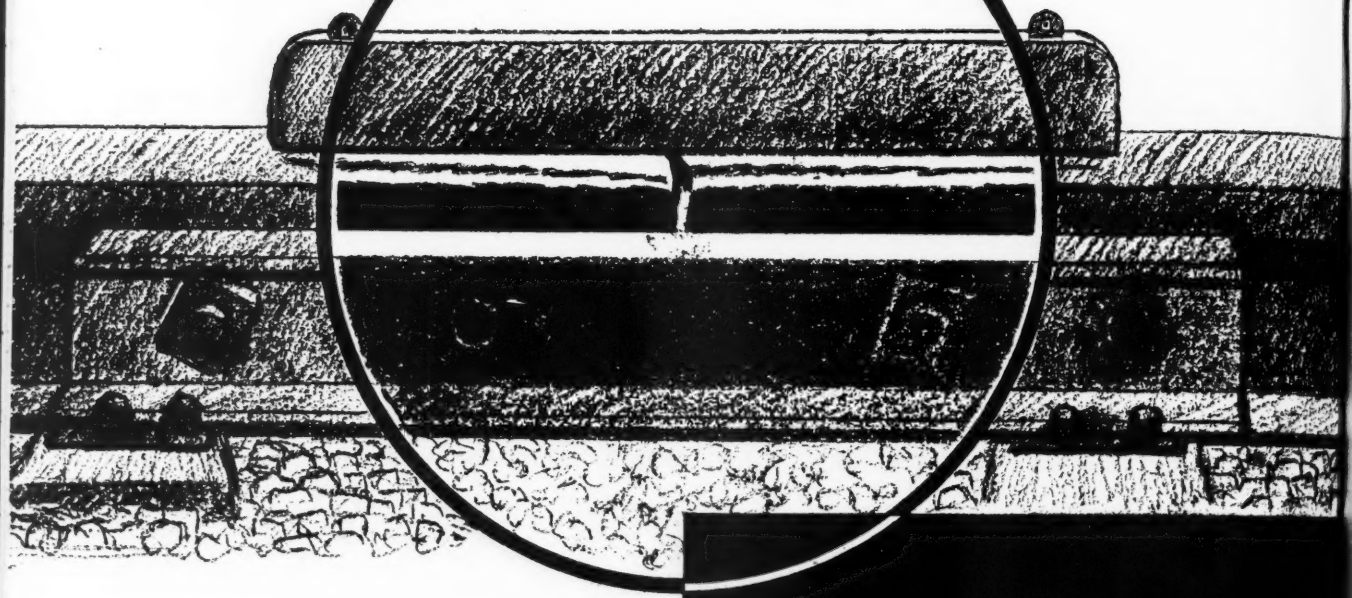

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Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

December, 1934

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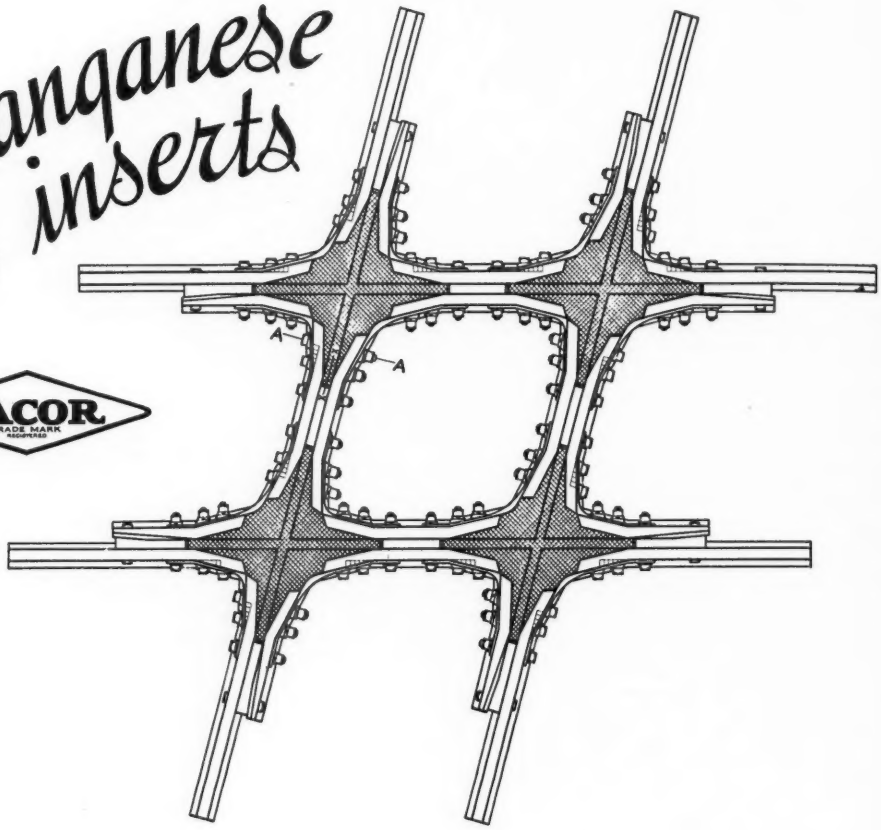

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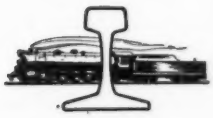


GRADE SEPARATION

An Ideal Activity for Work Relief

THE most serious problem confronting the country today is that of unemployment. Some 8,000,000 to 10,000,000 persons are without work. They and their families are largely dependent on public relief. The only permanent solution is, of course, the recovery of private industry to the point where it can take back those of its employees which it was compelled to lay off. Until this time comes, the support of those desiring but unable to find work becomes a public responsibility.

In the early days of the depression, unemployment mounted so rapidly that there was little opportunity to provide other than direct relief. As time passed, more and more effort has been made to replace the dole with work relief. This is the objective of public authorities at the present time and they are searching for projects which can be undertaken quickly, which require a large proportion of labor and which have a large measure of public benefit. Of such characteristics is grade separation on a large scale.

The Grade Crossing Problem

There are approximately 237,000 crossings of highways and railways at grade today. Originally of little public concern, these crossings have become a factor of importance with the great increase in the use of the highways and the still greater increase in the speeds thereon. This is measured in part by the killing of some 1,500 persons and the injury of some 4,000 additional persons annually in accidents at these intersections of highway and rail traffic. These figures are small compared with the death of some 33,000 persons and the injury of some 500,000 persons on the highways every year. Yet they are sufficiently large to direct attention to the desirability of eliminating as many of the most hazardous of these crossings as practical.

Grade separation, or grade crossing elimination, is not a new procedure. It has been in progress for years and has gained momentum, especially of late. Statistics compiled by the Interstate Commerce Commission show that a total of 10,341 crossings have been eliminated during the seven years 1926-1932, inclusive. Of these, 1,938 were removed by the separation of highway and railway grades and the remainder by the relocation of the highway, the closing of the crossing or the abandonment of railway lines. Yet during the same period, 11,726 new grade crossings were established, entirely offsetting the crossings eliminated and resulting in a net increase of 1,385 crossings. Present methods are not striking adequately at this problem, therefore. It is for this reason that the proposal to undertake a vastly increased program of grade separation as a form of work relief is now receiving serious consideration in several quarters. It has several reasons to commend it.

Grade Separation a Public Responsibility

In the first place, the separation of grades is a public responsibility. In the days of the horse and buggy the grade crossing constituted no problem, for there were few accidents and little demand for the separation of traffic. The problem arose with the change in the character of highway travel, a change for which the railways were in no way responsible. Recognition of this fact is evidenced by the steadily increasing proportion of the cost that is being assumed by the public, until early this year the federal government arranged to advance the entire cost of numerous projects to hasten their construction.

In this connection it is well to consider the source from which the railways derive their funds. There is nothing magic about railway income; it is derived solely from the charges levied on the public for the transportation of freight and passengers. The assessment against a railway of a proportion of the cost of a public improvement, such as the elimination of a grade crossing, is, therefore, merely, in effect, an indirect assessment against the public.

A secondary consideration in support of the proposal for the inauguration of a vast program of grade separation at public expense is the fact that the need for separation is widespread geographically. Furthermore, it varies largely with the density of population and, therefore, with the volume of unemployment. For this reason, it offers possibilities for work in the vicinity of the unemployment itself and largely in proportion to the degree of unemployment. Furthermore, expenditures for grade separation go very largely to labor, both skilled and unskilled. Likewise, they afford opportunity for the selection of materials, adding still more to the distribution of employment.

Still another factor of primary importance at the present time is the fact that highway grade separation work can be initiated with minimum delay. The railways and highway authorities have in hand completed surveys and tentative plans for hundreds of structures and others can be prepared quickly. The materials, for the most part, can also be acquired with little delay. Likewise, the rail-

ways have organizations prepared to direct or to co-operate in directing such work. In other words, this type of project lends itself peculiarly to the needs of the present emergency.

In considering a grade separation program at the present time, it is to be remembered that these crossings must be separated eventually. This being so, the direction of relief activities to such projects will effect a public benefit of permanent value and merely set forward work which would inevitably be done at a later date.

Protection and Abandonment Also Aid

In the study of this subject, recognition must be given to the large amount of protection that can be secured through the elimination of a limited number of crossings. Owing to the concentration of traffic in recent years on a smaller number of main highways, one large railway has found that the elimination of only 5 per cent of the crossings on its lines will remove 50 per cent of the hazard. Furthermore, not all of the relief need be secured through the elimination of crossings, for it is possible to afford adequate protection at many crossings through automatically controlled signals, such as flashing lights, etc. Likewise, it is also possible to eliminate many crossings by relocation and consolidation, an expedient which, while not contributing materially to the present emergency program, is one that should not be lost sight of in the complete consideration of the problem in its various phases.

It is because of these various facts—the desirability of transferring men from the dole to work relief, the large degree of public interest and benefit, the ultimate necessity of the work, the quickness with which activities can be initiated and the lack of other means of financing—that so many officers of the government and so many other public and private agencies are now looking with so much favor on a large scale program of highway-railway grade separation as a major contribution to the problem of unemployment relief. Because of their long and intimate contact with the grade crossing problem, railway employees can contribute materially to the constructive solution of a problem that must be faced.

BRIDGE INSPECTION

Should Be As Thorough in Winter As in Summer

THE necessity for inspecting bridges does not cease with the close of the working season, but this work should be continued through the winter with the same thoroughness and attention to detail that prevails during periods of milder weather. Cold weather does not eliminate any of the hazards that surround these structures; rather it adds to them.

Frost is one of the most insidious enemies of masonry. Evidence of its action is seen in spalling stone, in disintegrating concrete and in the outward movement of mortar in joints. The destruction of otherwise sound substructures and stone culverts can sometimes be traced to this action alone. But it should be borne in mind that frost does not affect masonry that is dry. For this reason, if frost action is apparent, it should be reported so that measures can be taken later to exclude the water that is primarily responsible for the damage. Backwalls, wing walls and, in rare cases, even abutments may be displaced by the expansion of wet embankments as a result of deep freezing. Particular attention should be directed to this possibility, so that drainage can be provided to correct the trouble.

One of the most aggravating effects of frost is the heaving of piles in trestles. Occasionally only an individual pile is affected; at other times it may be one or more whole bents. This is sometimes one of the most difficult items to check on an inspection, since the heaving may be slow and it may not have gone far enough to be noted at the time of the inspection. At other times a bent may rise quickly and this may occur within a few hours after an inspector has passed the structure. Some trestles never heave; others do so only at rare intervals; while still others give trouble from this cause every year. The inspector should be familiar with this feature of the history of every structure and should be careful to scrutinize very closely those that have given trouble previously.

He should likewise be familiar with the streams that are crossed, and should investigate the ice conditions both above and below the bridges; he should also observe whether a clear channel has been provided for the run-off when the ice breaks up. These precautions are specially important with streams that have given trouble heretofore.

All in all, bridge inspection during the winter requires attention to practically all of the details that are included in summer inspection and to a number of others which do not enter the picture at other seasons. It is apparent, therefore, that inspection should not be relaxed during the winter but, on the contrary, should be carried on as intensively as at other times.

RAIL

Why Are There So Many Patterns?

CONSISTING of two rails supported on a grid of crossties that rest in a bed of ballast, railway track would appear to be one of the simplest of engineering structures. Yet the distribution of stress under any given set of conditions is exceedingly complicated, while the opportunity for variation in the conditions imposed is so great as almost to defy exact determination. Therefore, in so far as it concerns the problem of rational design, railway track is among the most complex of structures.

This is particularly true of the rail, for although it has been used in its present T-shape for nearly a century, it is only recently that mathematical analysis of the stresses has been attempted, or that either laboratory or field investigations have been conducted on a sufficiently comprehensive scale to warrant conclusions as to the relations between actual field conditions and the range of stresses produced in the rail. Incidentally, the mathematics of stress determination in the head of the rail resulting from the combined bending action and the bearing pressure

under the wheel are so involved as to lie outside the understanding of all except the mathematician of unusual ability.

However, load-carrying capacity is not the only factor to be considered in the design of a rail section. There is, for example, the need for adequate fishing depth to provide room for a joint bar of sufficient strength and stiffness. Among other points to be considered are the ratio of the height to the width of the base to insure stability, and the thickness of the base to guard against failures due to uneven bearing, and to these considerations must be added those that arise in rolling rails of different shapes and proportions in the mill.

Thus, it is seen that the designing of a rail section, even with the engineering data now available, is no simple task. Actually, the designers of the early sections had a much easier job, because the absence of either experimental data or mathematical studies left them no choice but to adopt the process of trial and error. As a result, rails were made deeper or shallower, wider or narrower, thicker or thinner, according to the convictions of the designer, based on the behavior of rails previously rolled.

This procedure in rail design could have but one result, a multiplicity of patterns, each supported by opinion rather than mathematical or test data. A few roads based their studies on rather comprehensive service records, but except in the case of obviously unsatisfactory designs, one section could be defended about as readily as any other. In more recent decades progress in the co-operative design of rail sections has effected some reduction in the number of patterns, but as shown in the article on page 696 of this issue, there are still far too many. Surely the technical knowledge now available should permit of the rational design of a limited number of sections, among which would be found those which would meet the needs of all the varying physical conditions imposed throughout this country.

FIGHTING SNOW

Advance Preparation Wins Many Battles

AT this season of the year, no one question is more definitely before local operating and maintenance officers in northern climates than the amount of snow that they will be called on to cope with during the next three or four months. While the combination of heavy snow and low temperature is most likely to occur in January and February, severe storms may occur as early as December, and the heaviest snowfall of the winter sometimes comes as late as March. Even in April storms of sufficient severity to interfere seriously with traffic are not unknown in some sections.

In view of the long period over which snowfalls can be expected and the suddenness with which apparently mild storms sometimes develop to the utmost severity, with heavy snowfall, deep drifting and low temperatures, it is important that every preparation for keeping the lines open be completed by early December. It is particularly important that the equipment that is to be employed in this service be ready for the long period of use to which it may be subjected, for after a storm has begun, or even when it is approaching, there is no time to begin or complete preparations.

These preparations are of two kinds—those that can be made by the maintenance forces alone and those in which the mechanical department forces must participate. Among the former, snow fences should be set up and anchored adequately. The cribs at switch points and frogs should be cleared to provide proper drainage and allow room for the temporary accumulation of snow or ice without interfering with the operation of the turnout. Accumulations of cinders or other material in or between yard tracks, especially along ladders, should be removed. Out on the line all obstructions that might interfere with snow plows, flangers, or spreaders should be removed, including any excess of ballast above the ties. An especially rigid inspection should be made to discover defective rails and thus avoid the possible necessity of changing rails during snow storms. Every section should have its quota of small tools and snow brooms, and a supply of salt for use around switches and on platforms where this use is permitted.

Preparations in which the mechanical forces must participate include the overhauling of snow plows of all types, including rotary plows, and the mounting of snow plows on locomotives; and the overhauling of flangers, bulldozers and spreaders. Bulldozers and spreaders, which are primarily ballasting and grading equipment, are especially useful in handling snow in yards and for increasing the clearance in cuts after a storm has abated.

The importance of prompt and reliable information about snow conditions at all points cannot be overestimated. For this reason, telephone booths at critical points and at a few other and more convenient points will permit the section forces to keep the dispatcher advised without the delay consequent upon making long trips to stations. They are especially useful at night when many offices are closed.

Adequate preparation and prompt information as to conditions often mean the difference between keeping a line open and blocking or seriously delaying traffic until the storm abates. It takes some time and effort to make these preparations, but experienced maintenance officers know that they are worth while, since they may mean the difference between success and failure in fighting snow, while they are likely to pay for themselves during a single storm.

A Pile Trestle on a 30-In. Gage Line Near Melbourne, Australia

A Reporter Views Railroad's During Hardest

The winter of 1933-34 was the worst in history in Maine and for four months the Bangor & Aroostook waged a constant battle against record snow and cold. Recognizing the great public service that the railroad was rendering at a staggering cost to itself, the Bangor, Me., Daily News published an article which portrayed the valiant efforts of the railroad's employees in such a striking manner that it is reproduced in part on this and following pages.

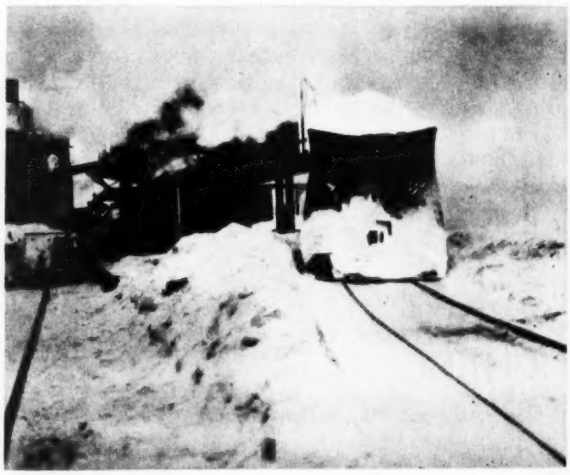
THROUGH all the winter of 1933-34, the most bitter ever known in Maine, which means the most bitter in New England—trains of the Bangor & Aroostook Railroad were kept running. In spite of almost insurmountable difficulties and hardships on the part of the railroad and its employees, the great empire of Northern Maine, buried in drifts, cut by cruel winds, faced by actual hunger if the railroad failed, received its daily service.

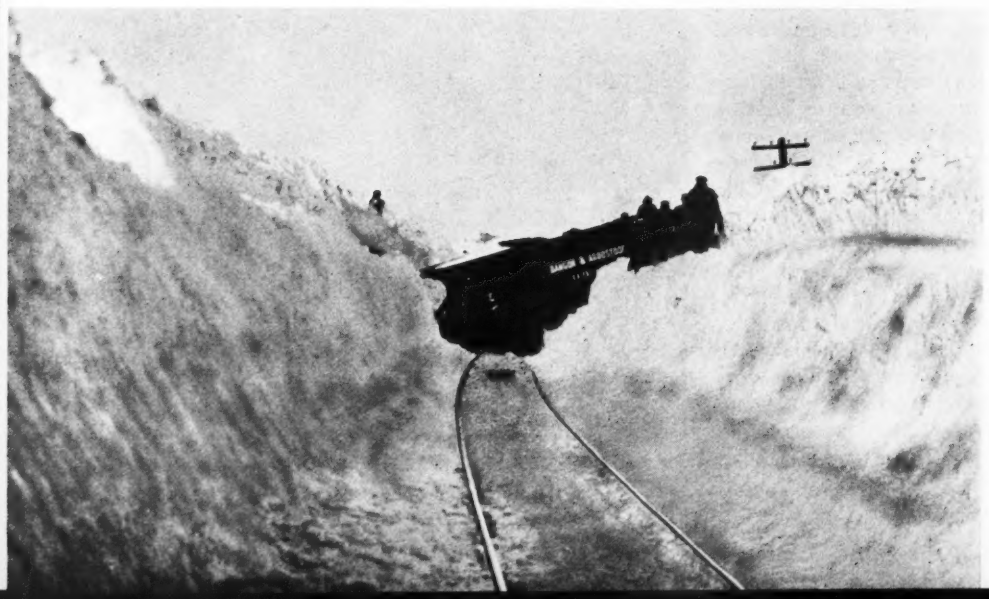
Beneath this simple statement lies a story of dogged courage and loyal devotion unparalleled in modern railroad history. Beneath the details of trainmen's and roadmasters' routine reports is a drama of human interest—the drama of how a little group of railroad officers and their loyal employees matched their brains and wills against the elements. Matched them for four unbelievably long months—and won.

Bangor & Aroostook officers and employees are familiar with Maine winters. Hardships that would discourage less rugged or determined railroad men are accepted casually, as matters of routine. "It's all in the day's work," they say, and their day's work is well done. But the period beginning December first and continuing well into March, was unlike any they had known—a nightmare turned to cruel reality. Cold, day after day and week after week, that played havoc with the rails and often cut through the heaviest clothing like the sharp thrust of a knife; temperatures that fell to 30, 40 and 50 below; snow, driven by high winds, that drifted in great piles across the long open stretches of roadbed —these called for every ounce of determination, sheer grit and red-blooded fighting strength in them.

Trains Kept Running

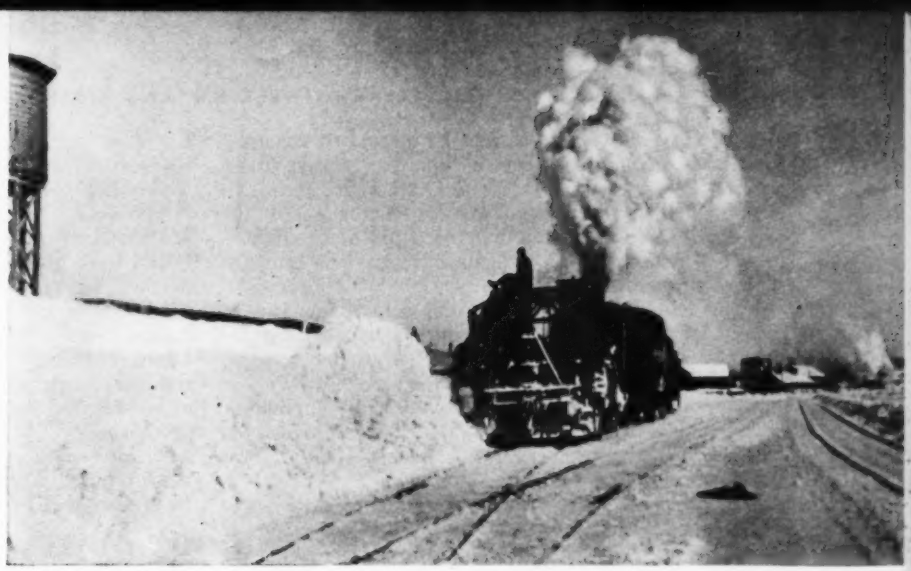
And the trains ran. It would have been much easier for the men, and highly profitable for the railroad to have suspended operations in those bitter months. Never for a moment, however, did such a possibility cross an officer's mind. Profit and loss, for the time, were unimportant. And so the railroad men arrayed themselves against the elements—with an experience that seldom erred, a vigilance that never slept, a fighting spirit that was unending. Arrayed themselves, because they knew, amazing as the statement seems, that almost



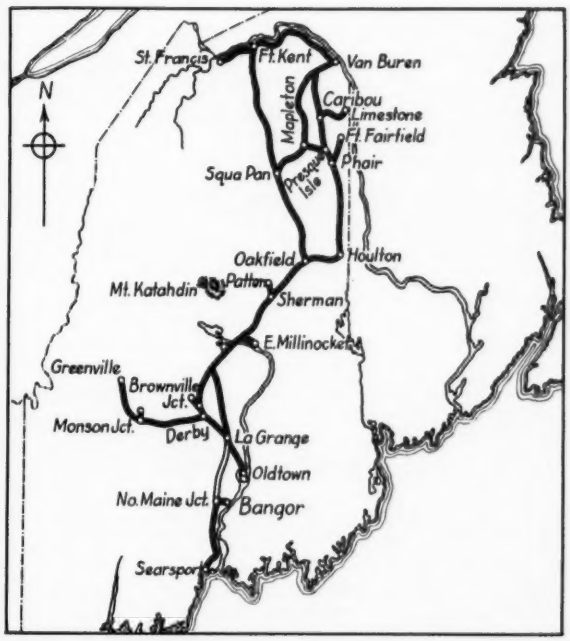


Above—Twenty-Three Plows Do Most of the Line Clearing and Drift Bucking. Left—A Plow Derailed in Clearing Out an 18-Ft. Terraced Snow Cut

Struggles Winter



Right—A Spreader Working in the Yard at Houlton, Me. Below—Line Map of the Bangor & Aroostook



the very life of the great empire north of Bangor, Me., was at stake. Arrayed themselves, from president to sectionman, in an unequal battle, adopting as their motto: "The trains must go through!"

The United States Government records, kept at Fort Kent, Me., show the total snowfall for the winter months, as follows: November, 35.5 in.; December, 34.5 in.; January, 29.5 in.; February, 23.0 in.; and March, 9.5 in., making a total of 132 in., or 11 ft. Significant too, is the fact that these original snows stayed throughout the winter, with little or no melting, there being no thaw in January, as is usual.

"Just how serious would the situation have been," an officer was asked by the Daily News, "had the trains failed to run?"

He hesitated a moment, "That's a pretty broad question and no one can give an exact answer. There would have been no actual starvation. Aroostook county had potatoes and other reserve food supplies, and branch lines of the Canadian Pacific touch it at Houlton, Presque Isle, Fort Fairfield and Caribou. However, that railroad was having a similar battle and did not reach any other points than the places mentioned. There would have been a very serious food shortage—no one can doubt that—and, perhaps, as the months passed, real suffering in remote communities. You remember what happened to America's food supplies during the war? People lacked many things and it would have been something like that in Aroostook if it had not been for our own private war against the elements.

Large Extra Forces Required in Battle

"None of us ever knew such a winter. There have been short periods when there has been as much cold, short periods when there has been as much snow—but the combination of cold and snow from December to March this winter, broke the records of recent years, and so far as there are figures to contradict it, the records of all times.

"Some days it was humanly impossible to move freights. But we can say this: 'Every passenger train, with its passengers, mail and express, got through.' Trains were hours late sometimes—but they reached their destinations.

"In ordinary winters, not much work is done on the tracks by section crews. About half as many men are employed as in summer. But this winter! Well, to give just one illustration: In February, 1933, we had 1100 section men. In February of this year we had more than 2300."

Although there were heavy snowfalls in December, the number of sectionmen was not materially larger than in normal years. The big increase came in January, February and March, as is shown by the following figures:

Number of sectionmen, including snow shovelers, in these months of 1933, and the cost: January, 585 men, cost $13,345; February, 1124 men, $17,764; March, 735 men, $18,247. Total cost, $59,356.

In 1934: January, 1599 men, $32,530; February, 2332 men, $41,413; March, 1473 men, $31,060. Total cost, $105,003.

Despite snow, ice, cold and every other obstacle imposed by the weather man, the flow of Aroostook potatoes—17,775 carloads—continued through December, January, February and March to the outer markets. The figures show:

Delivered through Northern Maine Junction for shipment via the Maine Central: December, 2,974 cars; January, 4,154 cars; February, 3,853 cars; and March, 4,363 cars. Total, 15,344 cars.

Delivered to Searsport for shipment via water: December, 461 cars; January, 1,040 cars; February, 481 cars; and March, 449 cars. Total, 2,431 cars.

At the request of the News, the officers of the road have made public a number of reports. Always, these reports are "matter of fact"; often they are technical. Superintendents and yardmasters are not adept in the use of adjectives. But the dramatic story of the fight—this fight by flesh and blood against Nature on a rampage—seeps through them.

From hundreds of such reports, only a few can be mentioned, taken almost at random. Perhaps these are no more important than many others, but they give an idea of the difficulties met and overcome.

Those by the roadmasters contain many highlights. The roadmaster at Millinocket, for example, tells what happened on December 30, when Millinocket yard was filled with snow.

"It was planned to start 'spreading' the yard, but a cruel wind whipped across it, and the mercury was 32 below. A number of extra snow shovelers had been engaged working with the regular section crews. Many of these men froze noses, cheeks, toes or ears. Some went home, but others stuck grimly to the job. After 9 a.m., those who remained worked with wraps over their heads."

At noon the roadmaster started spreading the yard. It was then 28 below and the wind had increased to 50 miles an hour. "We managed," he says in his report, "to get seven sidings spread, but the men would freeze their faces while putting out the wing of the plow. They would dodge into the plow, or behind something, while we were spreading the track: then go out, take in the wing and back under cover while we went to the north end of the yard again. We worked like this until late in the evening, or until we had finished what I had planned to do." He added simply, "It was cruel to ask men to stay out in such weather. I stayed with them, but almost perished."

There was no rest for the gallant Millinocket crew. Pressing on the heels of this storm there came another

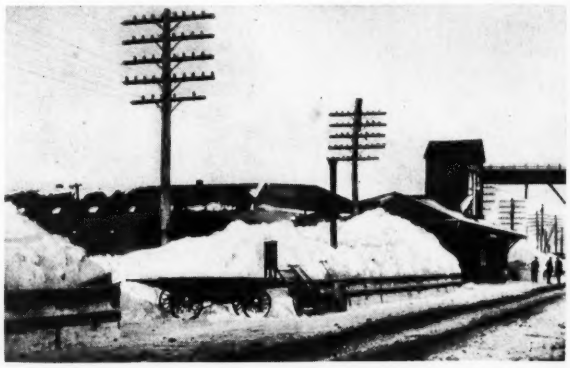
A Typical Terraced Snow Cut

several feet deep, burying the main line through Millinocket yard. The snow bank, for a half mile north of the station, was nearly to the tops of the telegraph poles.

Fifty men attacked the drifts on the main line, but the odds were too great for human beings to overcome. A man would shovel ten feet in two hours, only to find as much snow at the starting point as when he began. No one could see 50 ft. through the drifting snow-whirl. But they fought on for three days, following which the roadmaster put his men in another part of the yard where they were sheltered a bit.

The main line and No. 1 track through this part of Millinocket yard were buried six feet deep for a week. Plows were useless, as the snow was far above the tops of their wings. But ingenuity was equal to the task. The snow was shoveled on to racked cars, which were hauled clear of the yard by an engine and dumped. Later, the cut through the snow was widened by hand, the snow being put out over the top. Sometimes it had to be shoveled three times, making three terraces in the snow banks.

"The sectionmen were loyal to the Company," writes the roadmaster. "They responded to the call and stuck to their posts like beavers, doing all they possibly could.



Only the Start of a Real Winter on the Bangor & Aroostook

They froze noses and cheeks, and chilled hands and toes many times during the winter. There were few in my district whoses noses or cheeks were not peeling at different times."

Broken Rails Add to Problems

Now, this report by the Millinocket roadmaster is perhaps no more essentially dramatic, and reflects no higher courage than many of the others. It is given in some detail, because it is so typical—one vivid chapter illustrating a vitally human story. The battle of those in the track department in their efforts to keep the road clear, would, in itself, fill many columns. To mention only a few of many other episodes:

On December 28, the sectionmen in the yard at Northern Maine Junction, with the wind blowing a gale and the temperature at 35 below zero, suffered badly frozen faces. "My own face," writes the roadmaster, "was frozen in several spots during the day." On the day following, Searsport yard was cleared while the thermometer registered 40 below and a cruel wind swept in from the ocean.

Another roadmaster in charge of track reported:

"During my many years' experience in railroading on the Bangor & Aroostook, I have witnessed winters with as much snow, but never with the combination of wind, snow and cold weather that prevailed this winter * * * In some instances the snow had already drifted to such an extent (on the Fort Fairfield branch) that one of our big locomotives, with the Jordan spreader, was unable to penetrate the snow banks in the yards * * Never before have I had as many broken rails due to the long continued cold weather. Due to the great number, it was necessary for sectionmen to patrol the track behind all trains. On March 26, I had 26 broken rails in 35 miles."

Or these—among other statements from the roadmas-

ter at Fort Kent: "On January 1, at St. Francis, the snow drifted and froze so fast that it took nearly three hours to get the engine into the engine house. It was 40 below, and the wind was blowing a gale. January 16, 17 and 18 were three very bad days. Every man on the crew was frostbitten * * On February 25, I was on the Jordan spreader between Fort Kent and Van Buren. The snow had drifted so badly that at two of the sidings it had covered the flat cars completely. We had to locate them by feeling with our shovels in order to plow up to them with a snowplow."

Water Supply Was a Problem

"Ice," another roadmaster reports, "coated the inside of the company's 24-ft. water tanks * * despite fierce coal fires kept burning to keep them in operation." He tells, too, how a crew on the Aroostook River bridge, a gale blowing upon them and the temperature 40 below, wrapped their faces in towels. Yet their noses and ears froze, and blood flowed from cheeks split open by the cold. At Derby, where repair shops and houses for employees represent an investment of millions, the pipes were frozen and there was no water service for a month. There is a river in the town and emergency pumps were installed for fire protection, but employees were not allowed to drink this water until they had been inoculated against typhoid fever.

Other reports tell of some of the immeasurable obstacles overcome in the running of trains. On February 23, a storm, which had begun at 11 p.m. the day before, ended at three in the afternoon. Fifteen inches of snow had fallen. The wind whipped up, shifting the snow across the tracks in drifts. As the day wore on, conditions grew steadily worse. All freights were cancelled, and their crews and engines were pressed into service to aid passenger trains. Snowplow trains ran ahead of all these passenger trains. Two engines drew many of them, but despite all this, they were delayed from 1 hr. and 25 min. to 7 hr. and 48 min. The day was one long panorama of mishaps.

This View Was Taken at Derby, Me., on February 28, 1934

To follow all of the reports would be to repeat, over and over, the same courageous story—differing in detail, but always with the same background of dogged persistence and obstacles overcome. Now and then there are paragraphs so vivid or significant as to call for mention.

There was a heroic episode at Millinocket following the storm of February 22, when employees struggled to keep the second track east open as a main line. So intense was the cold and so bitter the wind, that many were badly frozen. The one in charge telephoned that the work must stop. It was almost inhuman to ask—or even to allow—the men to go on. But it didn't stop, for a crucial situation confronted the railroad just then. If that section were closed, the chances were it couldn't be reopened—which meant operations would have had to be suspended on the entire line until the weather moderated. And this it didn't do until well into March.

So the men worked—a few minutes at a time, which was all flesh-and-blood could endure. They would go to the station, thaw frozen faces or limbs, and grimly attack the job again. They won, and the main line stayed open.

A Double-Header Snow Plow Train Fueling Up Preparatory to Making Another Attack on the Line

And so on, day after day, episode after episode, storm after storm—all woven into a narrative that makes railroad history.

Successful Efforts of Men Win Praise

Such, briefly summarized, and with perhaps many of its most important features omitted, is the story of the gallant, bitter, four-month long fight. Hundreds of additional men, two and sometimes three locomotives on many passenger trains, freights provided with snow-fighting equipment, the greatly increased expense involved in reducing materially the number of loaded cars in each freight train—these, and many other things, made the cost of operation, as compared with the corresponding period of 1933, very great indeed. But president and directors felt it their duty to keep the road open. They knew that the great perishable crop of potatoes and other classes of freight, and the passenger trains with their mail and express, were necessary to life itself. They resolved that these trains should be kept moving—that Northern Maine should not be shut away from the rest of the world.

"No words of praise," the president and directors say, "can exaggerate the services of the company's officers and employees—especially those in the train service and those who worked on the tracks under such odds."

Can Rail Be Standardized?

A discussion of this question and the problems connected with it; how they affect the railways; the disadvantages accruing from rigid standardization

IS THERE excessive multiplicity of rail sections today? If so, how does this affect the railways? Is our knowledge of rail sufficient to permit fixing design rigidly today? If so, will rigid standardization be of value and in what way? Can a single standard be developed that will be acceptable to the roads as a whole? These are only a few of the questions that must be given consideration in any study of the desirability of standardizing rail design.

Concrete evidence that there is a wide diversity in rail design is found in the fact that one manufacturer is rolling currently 25 different rail sections in 10 weights ranging from 80 to 131 lb., while another is rolling rails of 49 different designs in weights varying between 65 and 131 lb. per yard. These are not isolated but typical examples. A similar situation exists at each of the eight mills rolling rails in this country. In fact, the number of sections for which rolls must be maintained is even greater at some of the mills than at those just cited. Although not all of these sections are being rolled at this time, one producer finds it necessary to carry rolls for 140 different sections in 24 weights from 65 to 152 lb.

What Is the Effect of a Multiplicity of Designs?

Would a reduction in this number of rail sections be of advantage? This question may be answered from two viewpoints, those of the railway and of the manufacturer. Obviously, it is of decided advantage to a railway to have only one design for each weight of rail. When this occurs, the problem of providing switches, frogs, joint bars, bolts, tie plates, anti-creepers, etc., is greatly simplified, and the stocks of these devices that must be maintained by the stores department can be largely reduced. Again, when ordering any of these materials for a given weight of rail, local maintenance officers need not be apprehensive about getting the wrong material, so that altogether, much confusion and expense in handling are avoided.

The foregoing refers to an individual road. Is there any advantage in two or more roads using identical designs? At first thought there is little to indicate that there is, for as long as a road has a single design for a given weight of rail, the fact that some other road may be using the same section is of no importance, so far as it affects the local material problems. On the other hand, if several roads are using an identical design, it will be much easier for them to obtain rollings of a common section, particularly if their tonnage requirements are small. There are also, of course, broader aspects to the question, which affect the cost of the materials and which have a direct bearing on the whole subject of rail and track accessories. To obtain a true perspective of these, however, it will be necessary to consider the question as it affects the manufacturer.

How the Manufacturer Is Affected

From the manufacturer's standpoint, each mill must maintain a set of rolls for every weight and section of rail rolled. A full set of rolls costs from $15,000 to $20,000, depending on the size of the mill, including the necessary spares, for every primary set of rolls must be protected by a duplicate set to insure against delays in case one or more of the rolls in the original set breaks or is otherwise damaged during the rolling, since from six to eight weeks are required to produce a set of rolls.

Roughly, a set of rolls is completely worn out after producing 25,000 tons of rails, although the roughing rolls are generally good for 50,000 tons, intermediate dressings being necessary at intervals of 3,000 tons for the roughing rolls and of 1,500 to 1,600 tons for the intermediate and finishing rolls. In other words, including the necessary dressings, the total cost of a set of rolls is about $1 a ton, assuming that the tonnage is sufficient to wear it out.

If an order for rails is large enough to wear out a set of rolls, it makes little difference to the manufacturer what the design is. However, orders of this size are rarely placed with a single mill at one time, since it is customary for the roads to divide their orders among several mills. As a result, when the rollings are completed, all of the mills involved are commonly left with partly worn rolls which must be stored until a subsequent order for the same section is received. If, as often happens, a road designs a special section and orders a relatively small tonnage, and later changes its design or decides to use a heavier rail, the manufacturer is left with a useless set of rolls on his hands, in which he has a large but unproductive investment. Yet, so long as the section remains in service he is not in position to discard the rolls because he is never sure that he will not be called on to roll the section again.

For these reasons, the storage facilities at every mill

in the country are filled with partly worn rolls, and with useless rolls which cannot be discarded, but which must be stored at considerable cost and inconvenience. In the aggregate, they represent a large investment, upon which interest and depreciation charges must be assumed annually. In some mills, even the storage of the rolls in current use is a problem of no mean proportions.

Furthermore, each design of rail requires a different design of joint bar, which may or may not make necessary also a change in the length of the bolt. A change in the design of the rail section may also require a different design or punching of tie plates and a revision in the design for anti-creepers. Experience has shown that new designs for these accessories generally accompany a change in the design of the rail. In any event, manufacturers of switches, frogs and crossings must provide new patterns and templates to correspond with any new design of rail. Obviously, therefore, the ramifications leading from a multiplicity of rail designs, or frequent changes in design, extend beyond the rail itself to reach manufacturers of track accessories and present to them problems similar to those that confront the manufacturers of rails. In other words, they cause a further economic waste through numerous duplications of rolls, patterns, dies, templates, etc.

This is the second article of a series dealing with the multiplicity of designs in track materials and tools. In the November issue, the problems of standardization were set forth, and the points of view of those who favor and those who oppose standardization were presented. The present article deals with rail design, and the problems that are facing railways and manufacturers by reason of the multiplicity of designs. Track wrenches will be featured in a discussion in the January issue.

How Does This Affect the Railways?

It is evident from the foregoing that both multiplicity and frequent changes of design are disadvantageous to the manufacturer and add considerably to his cost. For this reason, since the adoption of identical sections by several roads will tend to reduce the total number of sections, it is evident that such action will be of distinct advantage to him. It should be equally plain that whatever adds to a manufacturer's cost adds likewise to what the purchaser must pay, for sales quotations are based on the cost of production, including losses of the character which have been mentioned. No manufacturer can long remain in business who fails to pass on to his customers unamortized costs for rolls, dies, patterns, etc.

It should be borne in mind also that for commercial reasons, the original cost of a set of rolls cannot be assessed directly against the road placing the order, but must be amortized on a tonnage basis as the filling of the order progresses. For this reason, when losses of the character under discussion occur, they must be spread over the entire output of the mill.

In what ways do rail sections differ? A complete discussion of this subject would lead into many technicalities and be tedious. In general, when designing a rail section, a balanced distribution of the metal, vertical and lateral stiffness and the minimum tendency to overturn are among the features sought. Some roads prefer a deep head; others a shallow head. Depth of fishing is also an important element in rail design. It is astonishing, however, to observe how minor many of the differences in design are. Even the extreme range in the variations for a given weight of rail is sometimes surprisingly small, although in the case of certain dimensions the differences may be fundamental. That these differences are frequently so inconsequential as to have almost no influence on the service characteristics of the rail is illustrated by the composite drawing of 13 designs of 100-lb. rail in current use. These differences are also shown in greater detail in the table on the next page, in which all of the essential dimensions of these 13 sections are given.

Is Complete Standardization Practical?

For a number of years there has been a definite trend toward reducing the number of designs in current use. The first tangible evidence of this trend was the A.S.C.E. series of sections, developed in 1893, followed in 1908 by the A.R.A. series and still later by the A.R.E.A. designs. This is also confirmed by the fact that many of the 69 different weights and approximately 400 sections of rail still in the main tracks of the Class I roads alone are now obsolete so far as current rollings are concerned. In view of this trend and the extent to which the number of designs has already been reduced, there are those who contend that we are now ready for complete standardization. They contend further that the present situation with respect to design is the result largely, if not entirely, of organized effort and centralized leadership, and that rigid standardization can now be attained by taking such steps as may be necessary to accelerate the movement which they say is well under way.

Does an analysis of the underlying causes of this trend indicate that it is directed inherently toward standardization? One reason for the multiplicity of designs 40 years ago was that some of the basic principles of rail design were not then well understood. It was not until long after Wellington published his book on the Economics of Railway Location that it was recognized that "we do not care to buy steel but stiffness when we buy rail." Again, it was not until the A.R.A. sections were developed in 1908, that it dawned on engineers generally that the base of the rail should contain as much, or slightly more, metal than the head. General acceptance of these two principles removed automatically an important incentive to the changing of designs frequently, because the stiffer, balanced sections stood up far better under service, even with increasing wheel loads, than the lower, unbalanced, thin-base sections which preceded them.

While a marked reduction in the number of designs can be traced to a better understanding of the principles of design, further reduction can be traced to other causes. Among these, through mergers of independent roads, the number of officers engaged in rail design is smaller than during the period of the greatest multiplicity of designs. Moreover, many of these consolidations have involved roads having similar physical characteristics, so that a single design is satisfactory for all of the constituent lines. In addition, the recent practice of advancing the weight of rail by larger increments has been an important factor in reducing the output of new designs.

Is our knowledge of rail sufficient to warrant fixing designs rigidly today? There is no doubt that rail design as a whole is better understood now than it was a few years ago. There is little indication, however, that the

ultimate in design has yet been attained, a fact which is borne out by recent experience with the A.R.E.A. designs in sections weighing more than 100 lb. It will be remembered that in 1915, after seven years of intensive study, this association adopted two sections weighing 110 and 120 lb., respectively. After five more years of study, two additional sections weighing 130 and 140 lb. were adopted in 1920. Continuing its investigation for four more years, the Rail committee developed a section weighing 150 lb., which was adopted in 1924. Despite this intensive study for a period of 16 years, all of these sections were discarded in 1933 in favor of two sections weighing 112 lb. and 131 lb., respectively. Furthermore, still another section of rail, of a proprietary design, was developed and placed on the market in 1924, which has come into considerable use. In view of these facts, it is questionable whether we have yet reached that point in the development of rail design which precludes further improvement.

Of what value will rigid standardization be? It has been shown that a reduction in the number of designs is desirable to prevent the waste which results from both a multiplicity of designs and frequent changes in design. While it is obvious that complete standardization, that is, one design for each weight of rail, will eliminate this loss, in that it will insure that rolls will be worn out, this is practically the only important argument that we have in favor of rigid standardization.

Variations in Dimensions of Different Designs of 100-lb. Rail*

Total height	Width of base	Depth of head	Width of head	Radius top of head	Slope under head	Slope side of head	Radius corner of head	Fishing height	Thickness of web	Radius of web	Height of horizontal radius	Radius fillet under head	Radius fillet of base	Thickness of base	Slope top of base	Height of neutral axis
5-7/16	5-3/8	1-23/32	2-3/4	10	13°	4°	7/16	2-11/16	5/8	8	2-3/8	1/4	1/4	1-1/32	13°	2–35/64
5-1/2	5-1/2	1-7/8	2-13/16	10	13°	4°	7/16	2-11/16	5/8	8	2-9/32	1/4	1/4	15/16	13°	2.68
5-5/8	5-3/8	1-45/64	2-21/32	12	13°	3/64:1	7/16	2-55/64	9/16	12	2-63/128	5/16	5/16	1-1/16	13°	2.55
5-41/64	5-9/64	1-45/64	2-21/32	12	13°	3°	3/8	2-55/64	9/16	12	2-65/128	5/16	5/16	1-5/64	13°	2.63
5-11/16	5	1-13/16	2-43/64	10	15°	3/32:1	7/16	2-25/32	9/16	10	2-31/64	5/16	5/16	1-3/32	13°	2–81/128
5-45/64	5-9/64	1-39/64	2-9/16	12	13°	3°	3/8	2-61/64	9/16	12	2-79/128	5/16	5/16	1-9/64	13°	2-17/32
5-3/4	5	1-5/8	2-3/4	12	14°02′ 1:4	3°34-1/2′ 1:16	7/16	3	9/16	14	2-13/16	3/8	5/8	1-1/8	14°02′ 1:4	2.615
5-3/4	5-3/4	1-45/64	2-3/4	12	13°	Vert.	5/16	3-5/64	9/16	12	2-65/128	1/4	1/4	31/32	13°	2.73
5-3/4	5-3/4	1-45/64	2-7/8	12	13°	8°	1/2	3-5/64	9/16	12	2-65/128	1/4	1/4	31/32	13°	2.71
6	5-3/8	1-21/32	2-11/16	14	14°02′ 1:4	3°34-1/2′ 1:16	3/8	3-9/32	9/16	14	2-31/32	3/8	5/8	1-1/16	14°02′ 1:4	2-3/4
6	5-1/2	1-9/16	2-3/4	14	14°02′ 1:4	3°34-1/2′ 1:16	3/8	3-3/8	9/16	14	2-15/16	3/8	3/8	1-1/16	14°02′ 1:4	2.75
6	5-1/2	1-23/32	2-3/4	12	13°	4°	7/16	3-11/32	19/32	12	2-39/64	1/4	1/4	15/16	13°	2.875
6	5-1/2	1-5/8	3	14	14°02′ 1:4	3°34-1/2′ 1:16	5/16	3-13/32	19/32	14	3-1/8	1/2	5/16	31/32	14°02′ 1:4	2.90

*All dimensions in inches.

Is Rigid Standardization Necessary for Economy?

Is rigid standardization necessary for economy? Is there no alternative whereby the present waste can be eliminated? It has already been shown that there is little disadvantage to the manufacturer in some diversity of rail sections provided he is assured of a sufficient tonnage of each design to wear out his rolls within a reasonable time. In view of this fact, it is pertinent to ascertain how great a reduction in the number of sections now in use would be required to place rail manufacture on the most economical basis with respect to design. In other words, what is the limit in the number of sections for a given weight of rail beyond which there is little or no further economy from standardization? At the same time, how many sections are necessary to give ample opportunity for selection to meet the diverse needs of various roads, so chosen as to provide for the fundamental differences in height, head dimensions, fishing, etc., which now make rail design a perennial subject of controversy?

As evidence that a reduction in the number of designs is practical, attention is directed to the accompanying diagram which shows, superimposed one upon the other, 13 different designs of 100-lb. rail in current use and demonstrates quite clearly that three, or at most four, designs should cover all of the fundamental differences between these designs. In the same way, it can be shown that the multiplicity of sections now existing in other weights can be reduced in like degree and yet retain all of the fundamental characteristics of the several designs.

By reducing the number of sections to this extent, there would be required substantially no greater investment in rolls than by rigid standardization because of the fact that the rolling to a universally accepted design of a tonnage normally required by the railroads would be such as to necessitate several sets of spare rolls for operating reasons. It is evident, therefore, that it is not necessary to go to the extreme of rigid standardization on a given section for a definite weight of rail to secure economy of production, since this economic limit is attained through simplification long before rigid standardization is reached. Simplification thus provides the advantages of standardization.

On the other hand, it has also been shown that rigid standardization tends to retard, if it does not entirely bar, progress. The history of rail design is replete with evidence that improvements in design come slowly, sometimes only at long intervals. It required years to convince engineers that stiffness in rail was a requisite for successful resistance to constantly increasing wheel loads; yet this fact was susceptible of easy mathematical demonstration by any engineer who was capable of designing rail. In fact, although this principle was generally understood at the time, a relatively large group of engineers was willing to sacrifice the benefits of stiffness in order to obtain a large wearing area in the head, as is demonstrated by the B series of the A.R.A. designs, and by other designs of the same general type, some of which are still in use to some extent.

Is Single Benefit Enough?

One can only speculate as to what the effect would be today if rail design had been reduced to rigid standardization during the period of unbalanced, thin-base sections. The suggestion contains much food for thought, because of the generally recognized tendency of rigid standardization to retard initiative. Taking all of the facts into consideration, therefore, and bearing in mind the many indications that rail design has not yet reached the point where further improvement is impossible, it appears questionable whether the single benefit that can be claimed for rigid standardization is of sufficient value to offset its disadvantages at this time.

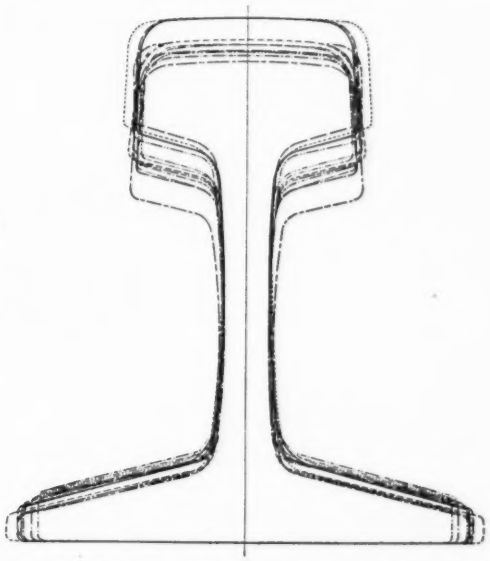
This seems particularly true in view of the possibilities that remain for still further reducing the present multiplicity of designs and of educating engineers to the disadvantages of frequent changes in design. On the surface, at least, there appears to be no reason why

small differences which occur in many of the designs in some weights, cannot be compromised. This in itself would eliminate a considerable number of the designs and be a long step in the direction of simplification, without the disadvantages of rigid standardization.

This is said in full recognition of the fact that in large measure, rail design is now, as it has always been, a matter of mathematics and experimentation which must be carried on in the field and mill, as well as in the office. It is only through this means that certain principles of design have been well established, but experience demonstrates that there may be others that must be developd in the same way.

Can a Single Rigid Standard Meet All Requirements?

Can a standard be developed, which will meet the requirements of all of the roads? On this subject, opinion is sharply divided, one group contending that a design



Composite Drawing of 13 Sections of 100-lb. Rail in Current Use

of rail that will serve one road should be equally satisfactory on another, and that differences in traffic densities can be cared for by using rail of different weights. Others maintain that there are differences in physical conditions, other than those relating to traffic density, that cannot be equalized by differences in the weight of rail alone.

Here, as elsewhere, however, facts are stubborn things. In the chaotic conditions of their day, the A.S.C.E. sections were hailed as the solution of all of the troubles that had been experienced with previous designs, and in a remarkably short time they accounted for two-thirds of the total rail production of the country. It was not long, however, before many of the roads discarded them as failing to meet their individual needs, although other roads persisted in their use for more than three decades.

Recognized by A. R. A.

These differences in physical conditions were recognized by the A.R.A., in its adoption of two distinctly different designs, the A and B series. Even when this provision was made, however, it was found that they fell short of expectations, and they did not gain wide acceptance. On the other hand, while the Committee on Rail of the A.R.E.A. also recognized these differences, and made them the subject of long discussion, the designs which were adopted in 1915 represented a compromise in which it was attempted to embody the features necessary to fulfill all of the requirements arising out of the wide range of physical differences which were known to exist. That these designs did not do this successfully is shown in the report of this committee to the 1933 convention in which it stated that, "Like most compromises, this one failed as it did not produce the best results that could be obtained with a given amount of metal. * * * * The considerable tonnage of rail rolled in the 110 and 130-lb. sections has been in use a sufficient length of time to demonstrate that these sections are not altogether satisfactory." In view of this record, it seems pertinent to inquire whether any other standardized design will be more successful than those that have preceded it.

Will Rigid Standards Be Acceptable?

Will the roads be willing to adopt rigid standards in rail design? The difficulty of developing a standard that will meet the needs of all of the railways has already been discussed. There are other obstacles in the way of such action, however, which should be mentioned. There is a very definite feeling on the part of many engineers that the officer who is responsible for the upkeep of the track is the best judge of his needs. Many of these men are individualists who are convinced that their own designs are superior to any design that is a composite of the ideas of a group that represents widely diverse experiences and conditions. Furthermore, in view of the failure that has characterized past efforts to standardize rail designs, they fear that the same stigma may attach to present and future efforts in this direction. To all of these must be added the natural conservatism of a large group, to whom the merits of any proposal must be fully demonstrated before they will accept it.

Difficulties Confirmed

In confirmation of the difficulties in the way of the adoption of a single standard for rail design, it is only necessary to point out that a number of the roads represented on the committee that designed the A.R.A. sections have never used either the A or B designs. In fact, several of the roads that were most active in securing the adoption of the B series have never used any of these sections. It is equally significant that several of the roads that collaborated in developing the A.R.E.A. sections that were adopted in 1915 and subsequently have never laid any rail of this design. How then, can it be expected that other roads will be willing to adopt designs, when the designers themselves refuse to do so?

As a further illustration that standards meet with passive, if not open, opposition, only a limited number of roads have as yet accepted the 1933 A.R.E.A. designs, despite open encouragement by the Federal Coordinator of Transportation. Of the 54 Class I roads which placed orders for rail in 1934, more than half used other sections. Of these, several continued to use the 110 and 130-lb. A.R.E.A. sections, while several others divided their orders, using the newer designs only in part. These facts provide a further demonstration of the reluctance of many of the railways to accept rigid standards.

If history repeats itself, it is to be expected that from time to time more roads will employ these new sections, but they will not come into universal use for many years, if ever. Every such acceptance, however, constitutes a further step toward the simplification of rail design, which, for the present at least, should be the objective of every railway engineer.

One of the Crawler Pile Drivers on the Illinois Central Bridge

A Pile Cut-Off Crew on the Y. & M. V. With the Pile Driver in the Background

Novel Roller-Mounted 13,800

By C. C. WESTFALL
Engineer of Bridges, Illinois Central, Chicago

The construction of two trestles across the Bonnet Carre spillway totalling nearly 20,000 ft. in length is now being pushed to completion by the Illinois Central. The necessity for extremely long piling imposed by unstable soil conditions required the use of unusual pile driving equipment which, in addition to other features of the work, is described in this article.

THE Bonnet Carre spillway, which is located about 22 miles north of New Orleans, La., consists of a concrete spillway structure, built as an insert in, or a part of, the main Mississippi River levee, and of a floodway with earthen guide levees extending from this structure to the shore of Lake Pontchartrain. It comprises a portion of the plan of the U. S. engineers for the protection of New Orleans against maximum floods. By reason of the control works on the river above this point, it is estimated that the maximum flood discharge in the river at Bonnet Carre will not exceed 1,500,000 cu. ft. per sec., and as it is planned to discharge 250,000 cu. ft. per sec. of this water through the Bonnet Carre spillway the amount passing New Orleans will be reduced to 1,250,000 cu. ft. On this basis, the spillway is to carry one-sixth of the quantity of the water which will pass down the river below it during floods.

As a matter of safety, the government engineers actually designed the spillway for a capacity of at least 50 per cent greater. The concrete spillway is 7,700 ft. in length, while the guide levees along the floodway between the river and Lake Pontchartrain flare to a width of 12,000 ft., center to center, near the lake. There is no other spillway in the world comparable to this one at Bonnet Carre, and I think it is safe to say that no railroad company has had to meet a problem in any way similar to this one.

The floodway crosses the single-track line of the Yazoo & Mississippi Valley about 5,000 ft. from the river, the single-track line of the Louisiana & Arkansas about two miles from the river, and the double-track line of the Illinois Central close to the shore of Lake Pontchartrain, or about 5½ miles from the river.

Ballast Deck Pile Trestles

At the Yazoo & Mississippi Valley crossing, the levees are 9,000 ft. apart, and it is expected that the depth of water in the floodway at that point will be about 14 ft. This has necessitated raising the railroad track approximately 13½ ft., and constructing a bridge 8,000 ft. in length, with embankments extending from the guide levees to the two ends of the bridge. The structure consists of a single-track creosoted, ballast-deck trestle,

*A paper read before the convention of the American Bridge and Building Association at Chicago, on October 17.

Compressor and A-Frame Hoist Used by the Capping Crews

This Crew on the Y. & M. V. Bridge Is Applying Sway Braces

Drivers Place Long Piles*

built in accordance with the standard construction of the Illinois Central System, but broken into 17 sections by firewalls and 35-ft. I-beam spans resting on concrete piers. The I-beam spans are located at approximately uniform distances apart throughout the length of the bridge at points where the topography indicates that the heaviest flow may be expected.

The Illinois Central crossing is being made by the construction of a double-track bridge 11,735 ft. in length, providing a raise in grade of the tracks of approximately 12 ft. This bridge will also consist of standard creosoted ballast-deck construction, together with 13 concrete fire walls, five 35-ft. I-beam spans on concrete piers and five 70-ft. through plate-girder spans on concrete piers. The spans and fire walls are so spaced as to break up the bridge into sections of approximately uniform length, with the steel spans located at points where the heaviest flow of water is expected.

The I-beam and girder spans at both bridges are to have reinforced concrete slab decks, so as to make them effective fire-breaks. The concrete work has been done by contract, but the trestle construction, together with most of the steel erection, is being done with railroad forces. The bridges are, in each case, being built at a sufficient distance to one side of the present tracks to permit construction of the bridges and the approach embankments, without interfering with the operation of trains.

The soil conditions, particularly at the Illinois Central crossing, are especially bad—the Illinois Central being built across a swamp of which the ground level is only about a foot above the level of Lake Pontchartrain. At the Yazoo & Mississippi Valley crossing, the soil is better, as the surface of the ground is higher; but the underlying soil is the same in both cases. Borings show that this material consists of very soft blue clay, the only hard stratum being a seam of fine sand that is located at an elevation varying from 70 ft. to 100 ft. below lake level. From the study of the borings, and the results of driving many test piles, it was found necessary to use piling varying from 78 ft. to 90 ft. in length at the Illinois Central bridge, and from 70 ft. to 78 ft. in length at the Yazoo & Mississippi Valley bridge.

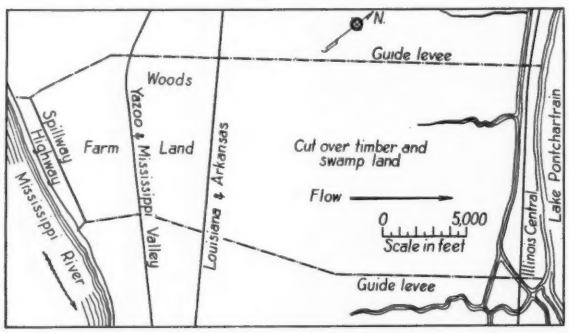
Special Pile Drivers

Because of the almost negligible supporting power of the soil in the swamp and the extremely long piles to be driven, ordinary pile-driving equipment could not be used. At the Illinois Central bridge it is necessary to support the driver on the piles as they are driven. At the Yazoo & Mississippi Valley crossing the ground will support a driver, but because it becomes so soft and muddy after the frequent rains, and also because the operation of the driver on the ground would have called for an increase of about 18 ft. in the height of the leads, it was decided to follow the same procedure on this bridge.

The magnitude of the job made it undesirable to use track equipment, as this would necessitate the construction of track as the work progressed, and would slow down the pile-driving operations. It was decided, therefore, to construct special creeper drivers which could be moved ahead on temporary caps without waiting even to line the pile bents. The requirements for such a driver, especially one for double-track work, are unusual and we were able to find few precedents upon which to base our design. After a great deal of study, we developed a design for a machine that is somewhat unique, but which has fully met our expectations. Four machines of this type were built, two for the Illinois Central and two for the Yazoo & Mississippi Valley, one being placed at each end of each bridge to drive toward the middle.

As pile drivers are of the same construction, except as to width, a description of the Illinois Central drivers will suffice. These drivers are built on a bed 50 ft. long and

20 ft. wide. At the front of this bed is a tower that is rectangular in front view and triangular in side elevation. It is guyed with heavy cables extending to the back of the driver, beneath the boiler and engine. The plumb and batter posts forming the legs at each side of the tower come together beneath a common cap 52 ft. above the bed. This cap supports a track upon which the hammer leads travel laterally. The leads are 68 ft. 6 in. in length, and are swung at a point 14 feet from the top. These leads are hung on an axle carried by a 30-in. wheel, and are moved across the track by means of swing lines operated by an engine on the driver deck and running on pul-



Map of the Bonnet Carre Spillway Showing the Crossings of the Illinois Central, the Y. & M. V., and the Louisiana & Arkansas

leys at each end of the cap. The movement provided for the leads is sufficient to permit them to be placed in the proper position for the driving of each pile in the 12-pile bent and they can be rotated in the transverse vertical plane, about the point of support to give the requisite inclination for the batter piles. The location of each pile is indicated by points marked on the cap upon which the leads travel and, in the case of the batter piles, there are holes in the beam in the front of the driver in which pins are inserted to hold the leads at the proper batter during the driving of the piles.

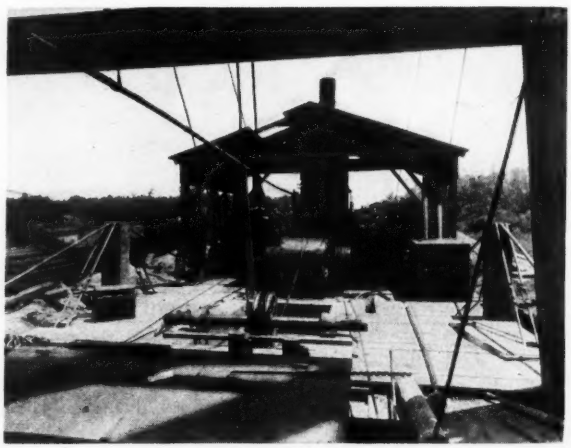
Driver Equipment

The driver is of timber construction, except for the necessary truss rods and portions of the leads. The mechanical equipment of the driver, consisting of boilers, hoisting engines and swinging engines, was obtained by

On the Y. & M. V. Showing the Present Main Track at the Right

dismantling our standard combination pile driver and derrick cars. Each pile driver is equipped with a double-acting steam hammer. On the Illinois Central bridge, the drivers are being operated 16 hr. a day, and each is equipped with a locomotive headlight generator and a gasoline generating plant to supply current for floodlights for operation after dark. The generating plant is installed on a platform in the tower. The locomotive generator was installed first, but was found inadequate for the purpose, and is now being used to supply current for the drop lights around the engine. The coal bin, built as an extension at the rear end of the driver, has a square frame at one side supporting a single sheave block, through which can be run a line from the drum of the engine. By this means, coal buckets loaded from the operating track and moved by push car, can be raised to the driver.

The piles are driven as nearly to final cutoff as practicable, but the six inside piles are driven slightly below the three at each end of the bent. These three piles at each side are then cut off to a temporary elevation and capped with a 7-in. by 16-in. stringer lying flat. Longitudinal stringers are laid flat on these caps, and the drivers are moved on wooden rollers on these stringers. The progress of the work will necessarily depend upon the speed of the pile driving, and this plan for moving the driver ahead without waiting for the permanent cut-off to be made saves a great deal of time. A portable gasoline air compressor placed on the ground near each driver furnishes air for an air-driven saw that is used for cutting off the piles and also for wood boring machines



A View From the Front of the Platform on One of the Illinois Central Pile Drivers

employed to bore the drift bolt holes for the temporary capping. Two air-driven cutoff saws are employed, part of the cut-off work being done with hand saws.

Cut-off and Decking Crews Follow

Each driver is followed by a gang that lines and spaces the piles, and cuts them off to final grade. These gangs also treat the pile cutoffs with creosote and then apply a mixture of pitch and creosote, and place the permanent cap. Following this work, other gangs brace the bents and place the stringer decking and floor.

The capping work is handled by a follow-up gang using a special skid device for hoisting the caps to position. This machine consists of a pair of skids with an A-frame at the front extending one panel length beyond the bed. Near the rear of the skids is a portable gasoline air compressor, and in front of this a small single-drum air-driven hoist which is used to lift the caps to position with a line running through a pulley block in the A-frame. The compressor also furnishes air for the wood-boring machine for drilling holes for drift-bolting the caps to the piles.

The work of placing stringers and building the deck

(Continued on page 705)

What Kind of Track Grinder?

Within a comparatively short time the track grinder has risen from obscurity to a position of importance in the list of power tools which the railroads employ in the maintenance of their tracks. Recognizing the need that has thus been created for information concerning the various types of grinders in use and the relative advantages of each type, a subcommittee of the Committee on Maintenance of Way Work Equipment of the A. R. E. A. compiled a report on the subject for presentation at the last convention. This report is abstracted herewith.

TRACK grinders have been designed and built to provide a more satisfactory and economical means of finishing welds on rails, frogs, and crossings, as well as of grinding off overflowed metal at switch points, stock rails, and in some cases on the low side of curves. Owing to the lack of suitable grinding machines in the early days of gas welding, the best work was obtained by the use of the flatter, and it is only recently that suitable grinders have become available. A much better service can be obtained by grinding after welding than by the use of the flatter.

The term "track grinder" applies to all types of grinders used in the maintenance of track, which may be classified as follows:

1. *Surface Grinder*—A surface grinder is designed primarily for finishing rail ends after welding. It may be used also for finishing frogs after welding and for grinding off side flow and irregularities on the top or sides of rails, frogs or switches.

2. *Cross Grinder*—A cross grinder is designed primarily for removing end flow of rail to prevent chipping.

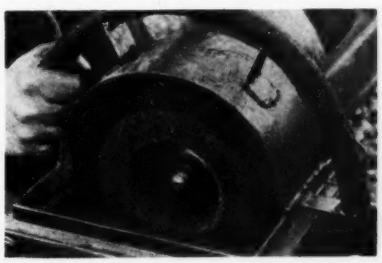
3. *Side Flow Grinder*—A side flow grinder is designed primarily for removing the overflow on stock rails in frogs and switches and also for smoothing up switch points.

The different types of grinders now on the market may be divided into two general classes as follows: (a) Those equipped with revolving wheels; and (b) those known as reciprocating grinders. In the latter type a group of carborundum blocks is carried in a frame or crosshead which slides back and forth on guides. The crosshead is operated by a connecting rod from a crank disc on a cross shaft which is driven by the engine, and the cutting speed is necessarily low, being not over 300 surface feet per minute. Consequently the grinding is done slowly, but it produces a perfect job; the blocks soon acquire the contour of the rail heads, the finished work is true and the two rail heads are brought to a perfectly level surface.

There are two kinds of reciprocating grinders—a double-sided heavy four-wheel machine equipped with a Ford power plant, and a light portable two-wheeled machine which may be easily removed from the track to permit the passage of trains. Obviously, the former does the fastest work, grinding a joint first on one rail and then the next joint on the other rail. The portable machine operates on one rail only.

Revolving Grinders

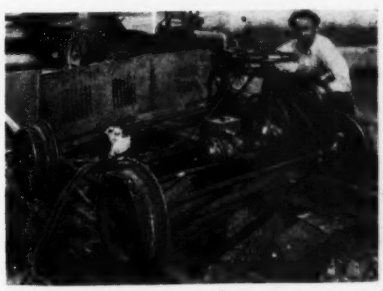
Grinders equipped with revolving wheels operate much faster than reciprocating grinders, the cutting speed of wheels that have bakelite or other synthetic bonds running up to 10,000 surface feet per minute. These ma-



A Cup Wheel Grinder

Stock Rail and Surface Grinder

Combined Surface and Cross Grinder



Electric Cross Grinder

Reciprocating Surface Grinder

Free-Hand Surface and Cross Grinder

chines may also be divided into two general classes—those using cup wheels and those using disc wheels. The former may be either of the free-hand type, driven by a flexible shaft, or the precision type in which the wheel is carried by a crosshead sliding on guides, the machine being clamped to the track.

Revolving disc wheel track grinders may be further divided into two classes. In the first class are constant-speed machines which are designed to maintain a uniform revolving speed. In the second class are the variable-speed track grinders which are provided with a range of speeds in order that a predetermined surface speed may be maintained as the wheel is worn to a smaller diameter. As an example of the importance of the speed adjustment on track grinders, a 12-in. wheel having a peripheral speed of 10,000 ft. per min., will lose approximately 33⅓ per cent of its efficiency when its diameter is reduced to 8 in. if the revolutions per minute remain constant.

The disc wheel grinders may be of the free-hand type driven by a flexible shaft, the wheel and guard being mounted in a suitable holder. This device is not the most satisfactory, as it is difficult to prevent the wheel from gouging in, resulting in a poorly finished surface. A more satisfactory arrangement is to mount the wheel in a frame which can be raised and lowered by a hand-wheel feed and moved from side to side of the rail head while the whole machine rolls back and forth along the rails over the joint that is being ground. This is not a precision grinder, although it is capable of doing good work rapidly. One disadvantage is the size and weight of the machine, another lies in the fact that it does not clear trains when placed in the intertrack space of a multiple track railroad. Moreover, the machine rolls back and forth on the rail heads, which are not true plane surfaces, and any irregularities in the surfaces of the rail heads will be reproduced in the ground joint. The wheels of the grinder truck may also be out of round, and care must be taken that the powdered metal and emery dust do not pile up on the rail.

Speed Chart for Grinding Wheels on Track Grinders

Wheel Diameter (Inches)	R.P.M. Required to Give 10,000 Ft. Per Min.
14	2,728
13	2,938
12	3,183
11	3,472
10	3,820
9	4,244
8	4,775
7	5,457
6	6,366
5	7,639
4	9,549
3	12,732

Another disc-wheel machine is of the precision type, in which the wheel is carried by a crosshead sliding on guides, the machine being clamped to the track.

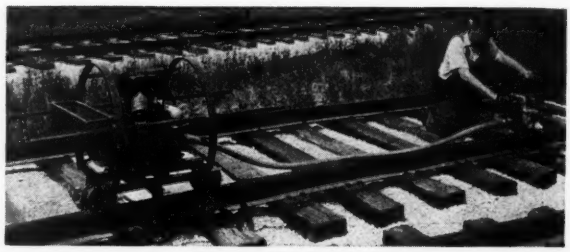
Cross grinding machines are either single sided or double sided, the latter being moved along the track, slotting a joint in one rail and then the next joint in the other rail. Some of these grinders are equipped with one thin wheel, usually ⅛ in. thick, and others with two wheels, one ⅛ in. thick for tight joints and another thicker wheel for open joints.

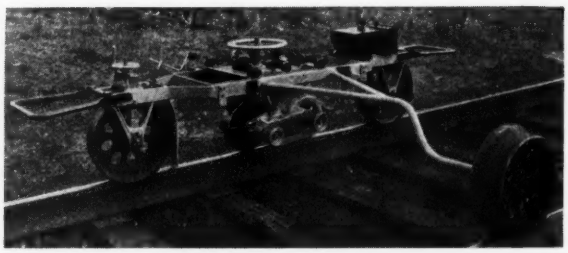
The following remarks concerning the design and maintenance of track grinders are listed in the order of their importance.

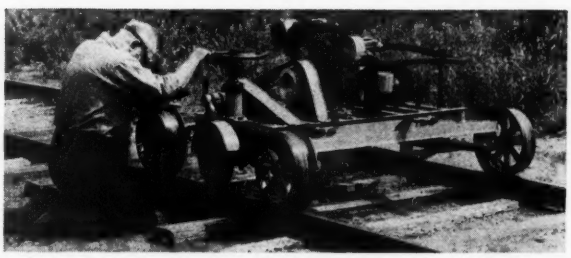
(1) The accompanying table which is compiled on a speed basis of 10,000 surface feet per minute, shows the revolving speed at which grinding wheels having a synthetic rosin bond should run. It will be noted that as the size of the wheel decreases the revolutions per minute must increase in order to maintain a predetermined peripheral speed. It is necessary frequently to check and correct the grinding wheel speeds in order to maintain a constant surface speed. Failure to do this may result in losses of grinding wheel efficiency up to 75 per cent.

(2) Gasoline engines are a desirable and economical source of power for operating track grinders. These engines are equipped with mechanical governors and adjustments are provided to maintain the variable speeds required completely to wear out the grinding wheels. This wide range of speeds is not provided by any other form of power.

(3) From observation of many different types of drives, it has been found that the V-belt, wherever it can be used, provides a very efficient and trouble-proof method of driving track grinding wheels. There are some instances, however, where metal flexible shafts are desirable, owing to the peculiar nature of the work, although these are usually used in conjunction with V-belt drive assemblies.







Top—A Gasoline Driven Precision Cross Grinder
Center—An Electric Driven Surface Grinder
Bottom—A Gasoline Driven Combined Surface and Cross Grinder

Lubrication Important

(4) The proper lubrication of grinding machines cannot be overstressed. Greases having a low sodium soap content are well adapted when various kinds of ball and roller bearings are used at very high speeds, such as are found in the better types of grinding machines. Ball bearings must run from approximately 2,500 r.p.m. to 12,000 r.p.m. which requires very thorough lubrication.

The grease referred to consists of approximately 95 per cent steam-refined cylinder stock and 2 per cent to 5 per cent sodium soap, and is used in preference to lime soap greases.

(5) Air cleaners on gasoline motors and crank case oil breathers must be provided when the engines are used on grinding machines, as the engines are required to operate in a virtual bath of emery dust. There are many types of air cleaners and breather caps on the market for this purpose, but few are efficient enough to be of any value under these conditions. Carburetor air cleaners embodying the oil bath principle have proved more efficient than any other type so far developed. This type of cleaner requires daily care if the best results are to be obtained.

(6) Of the many methods being used in providing the vertical feed on track grinding machines, few are positive and fast enough to insure good workmanship in surface grinding when the grinding is being done on a production basis. It is essential that the feed be positive in its downward movement of the wheel, and at the same time be so designed that it will release instantly when the feed wheel is turned in the opposite direction. Machines have been developed in which this feature was not considered, and as a consequence slack was present in the feed mechanism, which had to be removed before the adjustment would start to raise the wheel. This resulted in the formation of grinding holes beyond the end of the weld which are exceedingly undesirable.

(7) It is often considered necessary to apply excessive pressure to grinding wheels in order to maintain a rapid rate of cutting. It is more important, however, to use light wheel pressures and maintain high peripheral speeds than it is to attempt to crowd a grinding wheel by creating excessive pressure.

Driving 13,800 Long Piles

(Continued from page 702)

has only started, but on the I.C. bridge the timbers will be handled with locomotive cranes and on the Y. & M. V. work, with a crawler crane and track derrick car.

The material for the job is being unloaded and distributed with a self-propelled track derrick car. This derrick car has been developed by our bridge department over a period of about 25 years, and is one of which we are rather proud. Apart from the hoisting engine, its equipment includes a swinging engine developed jointly by our bridge department and an engine builder. This places the entire operation of the car in the hands of the hoisting engineer, and obviated the necessity for using anything but wire rope on the car. The car is also equipped with a locomotive generator to furnish light for night work. One of the cars used at Bonnet Carre has a 50-ft. steel boom and another a 55-ft. boom.

Water Supply

To furnish water for the equipment used on the Illinois Central work, as well as for the use of the contractor in the construction of the concrete piers and fire walls, a pipe line more than 13,000 ft. in length was laid from the water station at LaBranch, La., with a gasoline booster pump to furnish pressure. On the Y. & M. V. work, water, obtained from the large borrow pits formed in government levee construction, is delivered through a pipe line at each side of the flood-way by two-inch double-acting gasoline force pumps.

These two jobs are of such magnitude and the importance of rushing them to completion ahead of next spring's floods is so great, that we have tried to adopt such methods as will not only demonstrate economy, but will expedite the work as much as possible, and each piece of equipment has been selected with these objectives in mind. In doing this we have made no unusual efforts to employ a maximum of power equipment, but have used machines from our supply in all cases where they could be used to advantage and have purchased new equipment for operations on which its use could be justified economically.

Rate of Progress

At present, the two pile-driver gangs on the Y. & M. V. are averaging from 2 to 2.4 piles per hour, and the four shifts on the Illinois Central bridge are each driving from 2 to 3 piles per hour. The operations of lining and capping the bents and placing decking were delayed until the pile driving had become well organized and thoroughly under way, to insure that the progress on the succeeding operations would not suffer interruptions in the event that the pile driving was temporarily arrested or slower than normal. Consequently, the capping and decking has not been fully organized behind each driver.

The work is being handled by the bridge department of the Illinois Central System with a resident engineer in charge. A general foreman, with an assistant, supervises the timber bridge construction. The foremen and bridgemen are recruited from the local division organizations but are carried on the bridge-department payrolls. The pile driving started in July, and it is expected to have the Y. & M. V. bridge finished shortly after the first of the year, and the Illinois Central bridge by about the first of next April.

WHEN THE BOSS IS SOLD
ON SAFETY
His men will Follow.
This Foreman (Checking Time Table) was track laborer 7½ Years and Foreman 42 years.
Neither He nor any of his men were ever hurt sufficiently to cause loss of time, and he never had a motor car damaged.
Almost any one can do as well if he tries.

This Poster, Which Was Issued by the Committee on Education, Safety Section, American Railway Association, Demonstrates the Importance of the Maintenance Department as a Factor in Safety Education on the Railroads

Wood Preservation in 1933 in Further Decline

THE total quantity of timber given preservative treatment in 1933 amounted to 125,922,475 cu. ft., which represents a reduction of 31,496,114 cu. ft., or 20 per cent, as compared with the quantity reported in 1932, and a decrease of 65 per cent as compared with the peak year of 1929. The amount of timber treated in 1933 was, moreover, smaller than for any year since 1911. These figures, together with the data given below, are taken from the annual statistical report on wood preservation in the United States in 1933, which was compiled by R. K. Helphenstine, Jr., forest service, United States Department of Agriculture, in cooperation with the American Wood-Preservers' Association. These figures were released on November 1.

The railway industry maintained its status in 1933 as the principal consumer of treated timber, approximately 75 per cent of the total amount treated during the year being for the use of the carriers. The quantity of crossties treated, which has always constituted more than half of all timber treated, alone accounted for 54 per cent of the total. Crossties and switch ties combined amounted to 58.3 per cent of the total.

Railway crossties given preservative treatment last year totaled 68,089,695 cu. ft., a decrease of 37,046,754 cu. ft., or 53.3 per cent, from 1932, and the smallest quantity reported for any year since 1909, when compilation of these figures was begun. In that year, 62,079,036 cu. ft. of crossties were treated. Switch ties treated in 1933 amounted to 5,430,278 cu. ft., a decrease of 3,173,594 cu. ft., or 36.9 per cent, as compared with 1932. Of the eight classes of material reported, only two, poles and construction timbers, showed increases in 1933, as compared with the previous year, while the other six classifications showed decreases.

The quantity of piles treated, 9,172,871 lin. ft., was 904,804 lin. ft., or 9 per cent, less than in 1932. A total of 1,711,411 poles were given preservative treatment, which represented an increase of 464,411 poles, or 21.4 per cent, over the quantity treated in 1932.

Of the 22,696,565 crossties treated in 1933, which was 12,348,918 less than the number treated in 1932, 54.1 per cent were impregnated with creosote, 32.9 per cent were treated with creosote-petroleum mixtures, 8.7 per cent with zinc chloride, 3.1 per cent with creosote in mixture with zinc chloride, and 1.2 per cent with miscellaneous preservatives. The increasing popularity of creosote-petroleum mixtures is indicated by the fact that in 1932 only 23.9 per cent of the crossties were treated with such mixtures, while in the same year 63 per cent were treated with creosote alone.

As usual, oak ties ranked first in the number treated, with 8,067,404, or 35.5 per cent of the total ties reported. Southern pine ties were second, with 4,483,901, or 19.8 per cent of the total, while Douglas fir was third, with 2,596,194, or 11.4 per cent. Of the total number of ties treated, 12,114,463 were sawed and 10,582,102 hewed.

The switch ties treated amounted to 65,163,331 ft. b.m., a decrease of 38,083,142 ft. b.m., or 37 per cent, as compared with 1932. Oak ties comprised 71.5 per cent of the switch ties treated, southern pine 10.7 per cent, Douglas fir 8.6 per cent, gum 4.7 per cent, and maple 3.2 per cent.

Creosote consumed in the preservation of timber in 1933 amounted to 85,180,709 gal., a decrease of 20,490,555 gal., or 19.4 per cent, as compared with 1932, and the lowest figure reported for any year since 1921. The amount of creosote imported increased from 19.4 per cent of the total used in 1932, to 22.2 per cent in 1933, although this is still low as compared with 27 per cent in 1931, and 31.9 per cent in 1930. The consumption of zinc chloride decreased 2,677,334 lb., or 35 per cent, from 7,669,126 lb. in 1932 to 4,991,792 lb. in 1933. The quantity of miscellaneous salts used, 627,201 lb., showed a decrease of 242,039 lb., or 27.8 per cent, while miscellaneous liquids decreased 43,708 gal., or 47.2 per cent. The consumption of petroleum, however, which amounted to 13,230,745 gal., decreased only 368,857 gal.

Wood Preservation, 1909-1933

Together with consumption of creosote and zinc chloride

Year	Total Material Treated Cu. Ft.	Number of Crossties Treated	Creosote Used, Gal.	Zinc Chloride Used, Lb.
1909	75,946,419	20,693,012	51,426,212	16,215,107
1910	100,074,144	26,155,677	63,266,271	16,802,532
1911	111,524,563	28,394,140	73,027,335	16,359,797
1912	125,931,056	32,394,336	83,666,490	20,751,711
1913	153,613,888	40,260,416	108,378,359	26,466,803
1914	159,582,639	43,846,987	79,334,606	27,212,259
1915	140,858,963	37,085,585	80,859,442	33,269,604
1916	150,522,982	37,469,368	90,404,749	26,746,577
1917	137,338,586	33,459,470	75,541,737	26,444,689
1918	122,612,890	30,609,209	52,776,386	31,101,111
1919	146,060,994	37,567,247	65,556,247	43,483,134
1920	173,309,505	44,987,532	68,757,508	49,717,929
1921	201,643,228	55,383,515	76,513,279	51,375,360
1922	166,620,347	41,316,474	86,321,389	29,868,639
1923	224,375,468	53,610,175	127,417,305	28,830,817
1924	268,583,235	62,632,710	157,305,358	33,208,675
1925	274,474,538	62,563,911	167,642,790	26,378,658
1926	289,322,079	62,654,538	185,733,180	24,777,020
1927	345,685,804	74,231,840	219,778,430	22,162,718
1928	335,920,379	70,114,405	220,478,409	23,524,340
1929	362,009,047	71,023,103	226,374,227	19,848,813
1930	332,318,577	63,267,107	213,904,421	13,921,894
1931	233,334,302	48,611,164	155,437,247	10,323,443
1932	157,418,589	35,045,483	105,671,264	7,669,126
1933	125,922,475	22,696,565	85,180,709	4,991,792

Classes of Material Treated in 1933

	Cubic Feet	Per Cent of Total
Crossties	68,089,695	54.0
Switch Ties	5,430,278	4.3
Piles	6,203,613	4.9
Poles	30,120,843	24.0
Wood Blocks	388,538	0.3
Crossarms	313,440	0.2
Construction Timbers	12,156,752	9.7
Miscellaneous Material	3,219,326	2.6
Total	125,922,475	100.0

Crossties (Number) Treated by Kinds of Wood and Kinds of Preservatives, 1933

Kind of wood	Treated with creosote (1)	Treated with creosote-petroleum (2)	Treated with zinc-creosote (3)	Treated with zinc chloride	Treated with miscellaneous preservatives	Total	Per cent of total
Oak	6,768,222	863,711	224,604	204,955	5,912	8,067,404	35.5
Southern pine	3,659,016	776,016	.....	43,648	5,221	4,483,901	19.8
Douglas fir	5,228	1,527,444	483,949	579,573	.....	2,596,194	11.4
Ponderosa pine	.....	1,676,819	.....	.....	.....	1,676,819	7.4
Lodgepole pine	.....	1,074,052	.....	390,570	.....	1,464,622	6.5
Maple	388,587	394,383	.....	281,355	2,000	1,066,325	4.7
Birch	329,313	482,256	.....	120,593	4,000	936,162	4.1
Gum	630,881	241,253	.....	5,000	.....	877,134	3.9
Beech	407,227	190,000	.....	142,000	5,000	744,227	3.3
Tamarack	3,000	139,241	.....	95,134	248,400	485,775	2.1
Hemlock	.....	82,629	.....	95,232	1,786	179,647	.8
Elm	56,496	15,017	.....	7,336	2,000	80,849	.4
All other	20,259	5,514	.....	11,733	.....	37,506	.1
Total	12,268,229	7,468,335	708,553	1,977,129	274,319	22,696,565	.....
Per cent of total	54.1	32.9	3.1	8.7	1.2	.....	100.

(1) Includes distillate coal-tar creosote, creosote coal-tar solution, refined water-gas tar and water-gas tar solution.
(2) Includes distillate coal-tar creosote, creostoe coal-tar solution, refined water-gas tar and water-gas tar solution in mixture with petroleum.
(3) Includes distillate coal-tar creosote, creosote coal-tar solution, refined water-gas tar and water-gas solution in mixture with zinc chloride.

Cement-Bound Macadam Makes Low-Cost Shop Runway

Wide usefulness seen for paving method used by C. & O., which completed job without heavy equipment or special material purchases

WHAT is believed to be the first cement-bound macadam built by a railroad since the old days when it was known as Hassam pavement, was completed in June by the Chesapeake & Ohio at Huntington, W. Va. The cost was quite low, only simple equipment and readily available materials were used, and a pavement suitable for heavy stores trucking was obtained. Cement-bound macadam is simply coarse stone aggregate (ballast) penetrated with cement-sand grout that fills the interstices between the stones and binds them into a concrete-like mass.

Although the methods used at Huntington were dictated to some extent by local conditions, the process conformed closely to the findings of a recent investigation of cement-bound macadam made in a test road at Elmhurst, Ill. This test, concluded a few months ago by the Portland Cement Association, included exhaustive studies of suitable aggregate sizes, sand grading, grout design and construction methods. As a result, cement-bound macadam can be designed rationally for given loads, and its strength and other qualities may be controlled with an accuracy approaching that of mixed concrete.

Briefly outlined, the procedure in building cement-bound macadam is to prepare the subgrade; spread and compact the coarse aggregate, checking the surface with a straight-edge or template; dampen the aggregate and apply the grout; finish by hand, again checking the surface smoothness; and then cure. Material meeting A.R.E.A. specifications for stone ballast (¾ to 2¼-in.)

Appearance of the Coarse Aggregate Struck Off, Compacted and Ready for Grouting. Reinforcement Shown in Foreground

has slightly too much range for this use, but will serve if practically all of the sand used passes a No. 14 sieve. When A.R.E.A. specification gravel ballast is used, the particles under ¾-in. must be removed.

The runway at Huntington, which was built to replace an old timber runway, is 370 ft. long and 10 ft. wide, with an average thickness of 8½ in. It carries tractor and trailer units hauling miscellaneous stores materials. The loads range up to 2,000 lb. per wheel but average considerably less. However, many of the trailer units have steel tires. Hence, slab strength was considered secondary in importance to wear and impact resistance.

The cinders for the base came from an adjacent pit. The concrete materials consisted of ordinary crushed stone ballast, a carload of engine sand, and the cement. Planks for the side forms were taken from the old runway. Stone forks, shovels and the other small tools needed were obtained from the storekeeper, and the water came from the yard-service lines. The reinforcement used was scrap material. Shop tractors and yard engines brought in materials as needed. A one-bag mixer was used for mixing the grout. The work was done by a bridge and building gang, assisted by the yard forces.

The ballast graded from 1 in. to 2½ in., but contained a small amount of screenings and dirt. By shaking the

The Grout Was Deposited Over Areas Already Penetrated, and a Metal Plate Used to Break Its Fall and Protect the Stone from Dislodgment

stone with ballast forks as it was transferred to place, it was possible to eliminate the small material and bring the stone to a satisfactory grading with little extra labor. The engine sand used in the mortar was finer than that recommended in the report of the Elmhurst tests, much of it passing a No. 28 sieve. It was also very smooth, and for this reason more water was needed to get the desired consistency than would have been required for sharper sands had they been used.

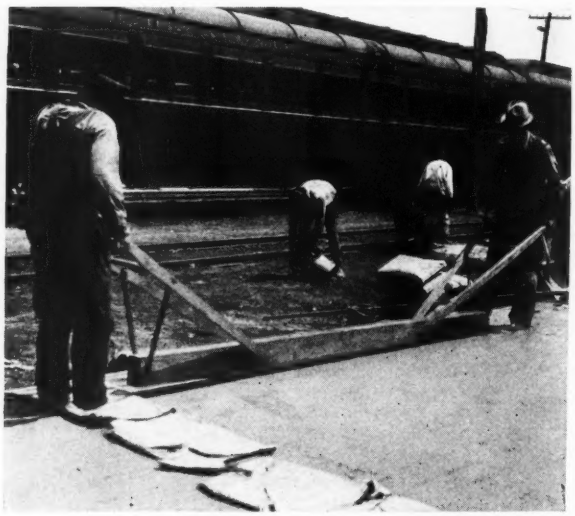
Grout Checked with "Flow Cone"

One sack of cement to 188 lb. of sand (about 1:1.7 by volume of dry and rodded sand) was used in the grout. Fluidity was controlled with great care, as this factor directly affects both the thoroughness of penetration and the time interval between grouting and final finishing. Just enough water was added to assure ready penetration.

Fluidity was measured with a "flow cone," a newly perfected device in which the flow from the cone gives a measure of the penetrating qualities of the grout for a given aggregate. This showed that a flow time of 20 to 21 sec. was best for the sand and coarse aggregate used in this work. Between 10 and 11 gal. of water per sack of cement were required, as against the 7 to 8 gal. that are normally sufficient for coarser and sharper sands and a coarse aggregate with a smaller range in the particle sizes. However, the excess water rapidly drained away into the subgrade, evaporated or was absorbed, so that a good surface finish, as well as a low water-cement ratio, was obtained within 30 to 45 min. after the grouting had been completed.

Rolling the Base and Spreading the Aggregate

As it was essential to keep the subgrade from working up into the aggregate voids, the subgrade was thoroughly wetted and compacted with a roller consisting of a steel cylinder 33-in. in diameter and 5 ft. wide, filled with concrete. It weighed 900 lb. per lin. ft. and was drawn by a wheel tractor. Areas close to the forms were



This Home-Made Tamper Compacted the Concrete and Prepared the Surface for Finishing With a Wood Float

hand tamped. The rolling was continued until the tractor tires made no impression.

The stone was then shaken out and placed uniformly to a depth of three inches. Following this, the reinforcement was laid, this consisting of five lines of longitudinal rods with transverse rods at two feet intervals. Then the top layer of aggregate was placed, struck off to a one-inch crown, and compacted with a heavy plank template. Except where a boxed-in steam line was crossed, no transverse expansion joints were provided, but a temporary wood bulkhead was placed at the end of the work at the close of each day.

Grouting and Finishing

Grout was deposited direct from the mixer or by wheelbarrows and was always placed so as to flow forward from an area already penetrated, thus avoiding the imprisonment of air. The fall of the grout was broken by a shovel or a metal plate placed on the stone to prevent its dislodgment. The grout was pushed ahead with floor brooms until only the tips of the stones were visible. To check the penetration of the grout, small test holes were scooped out ahead of the advancing grout, and it was found that the mortar quickly flowed into the hole after the grout had reached the surface of the stone within one to two feet of the hole.

Finishing Procedure

The finishing procedure also followed recommended practice, being accomplished by a home-made longitudinal hand tamper and a long-handled wood float. The tamper consisted of a 4-in. by 6-in. oak timber, 10 ft. long, with plow handles at the ends. The tamping was done to squeeze out excess water, eliminate pockets and increase the density of the slab. In spite of the large amount of water required in the mix, fast work was necessary on account of the heat and the "thirstiness" of the cinder base. Tamping was begun as soon as the mixer could

Grout Flowing into the Bottom of a Hole Dug in the Ballast Shows the Rate of Penetration

be moved ahead. The operation was to set the tamper along one edge parallel with the forms, raise it one foot and drop the two ends simultaneously, and then shift sideways about three inches at a time, until the other edge of the slab was reached. Special attention was given to the correction of local inequalities. Immediately after the first tamping, the surface was floated with a wood float. This was repeated after 30 min. The final finish was obtained by dragging a wet burlap blanket over the surface.

After the burlap finishing, the surface was sprinkled and as soon as possible, old cloths, pieces of burlap and other coverings were applied and wet down. The covering was kept wet for at least three days, to insure maximum wear-resisting qualities of concrete pavement.

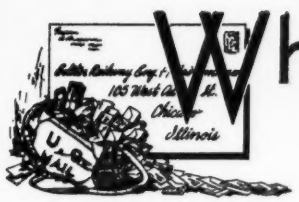
Material Quantities

To produce the 103-cu. yd. volume of the slab, it was necessary to use 110 cu. yds. of ballast, the difference being due to the compacting, loss in the subgrade and waste in handling. The following figures show the quantities of material used and the labor.

Cement	113 bbl.
Ballast	110 cu. yd.
Engine Sand	30 cu. yd.
Labor	500 man-hours (approx.)
Foreman	50 man-hours (approx.)

The labor shown does not include preparation of the subgrade and the cinder base.

The work was done under the supervision of M. I. Dunn, Jr., division engineer of the Chesapeake & Ohio at Huntington, W. Va.



What's the Answer?

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions that you may wish to have discussed.

To Be Answered in February

1. *When laying rail, what precautions can be taken to prevent later damage to the rail ends?*
2. *Under what conditions are borings justified to obtain data on subsoil conditions in advance of the driving of piles? What other methods of exploration can be employed to advantage?*
3. *What is the most satisfactory range of sizes for stone ballast? For slag? For washed gravel? Do the character or density of traffic, or other conditions influence this range?*
4. *How many coats of paint should be applied to new wood surfaces? To old surfaces when repainting? Why? What difference, if any, should there be in the composition of each coat?*
5. *What is the maximum variation from standard guard rail gage that is permissible? Why?*
6. *Should a power-operated pump be belt-connected or driven through gears? What are the advantages and disadvantages of each method?*
7. *Should tie plates be cambered? Why? Are there any disadvantages?*
8. *How can a turntable foundation be constructed under traffic?*

Drainage at Switches

What special provisions should be made at this season to insure adequate surface drainage and prevent the accumulation of ice around isolated switches during the winter? Around ladder and other yard switches?

Give Ample Clearance for Moving Parts

By A. R. JONES
Division Engineer, New York Central, Albany, N. Y.

Isolated switches, whether power or hand-operated, need to have clean ballast of ample depth so that the subgrade, and particularly the shoulder of the subgrade, is maintained well below the bottom of the tie. The ballast should be kept down in the cribs to provide ample clearance underneath the working parts of the switch.

Around ladder and yard switches, particularly those that are power-operated as in classification yards where the ladder leads off from a hump, stone ballast and subsurface drains, backfilled with porous material and provided with surface inlets at each switch, have proved to be very satisfactory. Commonly the ladders away from the hump contain many inside switches, making the subsurface drains very desirable. Power-operated switches on outside ladder tracks usually drain very satisfactorily if clean stone ballast is used and the shoulder of the roadbed is kept well below the ties. The ballast in the cribs should be maintained with ample clearance for the moving parts in such ladders as well as in the inside ladders.

Hand-thrown switches, which are generally installed on switches ballasted with cinders, will normally drain in a satisfactory manner, provided the ballast is trimmed down in the cribs and on the shoulder, with the dual purpose of providing the proper clearance for the moving parts and an outlet for the switch drainage that is lower than the surface of the ballast in the cribs.

Provide Best Drainage Possible

By W. E. TILLETT
Assistant Foreman, Chesapeake & Ohio, Maysville, Ky.

Drainage trouble in yards often becomes of major importance and may seriously affect the yard operation if not corrected, since defective drainage is quite likely to cause accumulations of ice that will slow down the handling of the switches. The surface of a yard is usually quite flat, with little opportunity for effective surface drainage, for which reason it is usually necessary to resort to subsurface drainage to create satisfactory conditions. Assuming that the general problem of drainage has been solved satisfactorily, the next important thing is to get water away from the individual turnouts in the least time and the most effective manner possible. This can be done by means either of surface inlets to the subsurface drains or rock-filled trenches which will lead the water to these drains.

When preparing for the winter, the ballast in the cribs where moving parts operate should be removed to a depth of three to five inches below the tops of the ties to insure ample clearance for these moving parts. Shoulders which retard drainage should be removed and all drains and inlets cleaned thoroughly to insure that there will be nothing to obstruct the free and rapid flow of the drainage water. Fully as important, the foreman should make sure that he has the proper supply of tools and materials available for cleaning and thawing ice and snow from the switches.

See That the Drainage Is Adequate

By District Engineer

This is one of the many questions to which the general answer is, provide drainage. Specifically, however, several important measures can be taken just before winter sets in to insure the best possible conditions around switches during cold weather. Every switch, whether in a yard or at some isolated outpost, should have the ballast removed from those cribs that contain working parts. The ballast remaining should be low enough to provide for some accumulation of snow or ice without interfering with the operation of the switch. The reason for this is that during severe storms or a sudden

drop in temperature after a period of thawing, it is not always possible for the section forces to attend to some of their switches at once, and they should be in condition to run long enough to allow them to be reached in the regular routine.

There is seldom any source of water other than precipitation, at isolated switches and, in general, an outlet for quick drainage from the crib can be provided through the ballast shoulder to the shoulder of the roadbed. If the conditions require special provision for drainage, this should be cleared up by early fall, as it is seldom practicable to take care of special drainage problems when winter is at hand. In other words, the general preparations should be such that only the seasonal tasks remain to be done, but these are important and should never be neglected. Much expense as well as delay to traffic can be avoided if these special tasks are attended to at this time. While they are seldom difficult and are rarely neglected on yard ladders and other busy switches, there is always the possibility that isolated switches may be overlooked. Such an oversight may be equally embarrassing to the operating and maintenance departments when it becomes necessary to use the turnout.

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Double-Shoulder Tie Plates

What are the advantages of double-shoulder tie plates as compared with single shoulder? The disadvantages? What effect, if any, do they have on maintenance?

Increase Life of Ties by Reducing Gaging

By ROBERT FARIES

Assistant Chief Engineer-Maintenance, Pennsylvania, Philadelphia, Pa.

Shoulders on tie plates take the thrust of the rail and transmit it to the tie through the bearing area of the tie plate and spikes, acting as a unit instead of bearing directly against an individual spike, thereby reducing to the minimum the amount of labor required to maintain gage, and giving increased life to the ties by reason of the less frequent respiking. Shoulders on tie plates also reduce the throat-cutting of spikes. Double shoulders possibly retard the creepage of rail.

Double-shoulder tie plates can be applied only in correct position with respect to the tie and rail base. They thus prevent excessive sluing of the ties and, by reducing lateral motion of the rail ends, provide better joint conditions. They still further reduce maintenance costs by reducing the amount of labor required to maintain line and surface. Double-shoulder tie plates are, of necessity, designed for a rail section with a given width of base, which prevents them from being used with other sections having different widths of base. This is about the only objection to this type of plate, since the additional cost for the second shoulder is very small.

Has Been Using Them for Five Years

By H. F. FIFIELD

Engineer Maintenance of Way, Boston & Maine, Boston, Mass.

We adopted the double-shoulder type of tie plate in 1930 and have been using them ever since. We find that they have the following advantages:

They are easier to install, since there are fewer cocked plates, which have been the cause of many broken rail bases. A better line can be maintained with them, since the inside shoulder prevents the rail from sliding down on the inclined surface of the canted plate. They practically eliminate the throat cutting of the spikes on the inside of the rail, which is so noticeable where single-shoulder tie plates are used.

They provide a more rigid track structure and prevent the sluing of the ties. The shoulders strengthen the plate and overcome the tendency of the plate to bend at its weakest point. Where a rail is broken, there is less likelihood of derailment, owing to the fact that the rail is held rigidly between the two shoulders. It has no disadvantages, not even of high cost, since the extra cost for the second shoulder is negligible.

Track Does Not Buckle So Easily

By R. E. PATTERSON

Division Engineer, Lehigh Valley, Easton, Pa.

Double-shoulder tie plates have many advantages over the single-shoulder variety. Among these, we have found that they give a more rigid track construction. By reason of this, when raising track in hot weather, the likelihood of the track buckling is practically eliminated. This type of plate also gives better alinement, not only on tangents but particularly on sharp curves where the joints in the low rail tend to kink in toward the center of the track. Poor gage and line often occur with single-shoulder plates, owing to wear in the spike holes and to throat cutting of the spikes. Since this wear is practically eliminated by the double-shoulder tie plate, both gage and line are improved by its use.

Double-shoulder tie plates also provide added protection in the event of a broken rail. They do not allow the cutting of the spikes and this prevents lateral motion of the rail, so that in this manner double-shoulder plates increase the life of the ties and the bolts and, in general, of the entire track structure.

No Disadvantage in the Double Shoulder

By LEVI C. MANN

Section Foreman, Cleveland, Cincinnati, Chicago & St. Louis, Hillsboro, Ill.

As a means of emphasizing the advantages of the double-shoulder tie plate, I shall point out some of the disadvantages of the single-shoulder type. Plates of the latter type allow the inside spikes to become throat cut, which permits lateral play of the rail. This is particularly noticeable in hot weather when the rail is tight from expansion, as it results in many minor kinks, or a wavy line, and tight gage. Single-shoulder plates also allow poor line and incorrect gage where guard rails are attached to the running rails, since the inside spikes often become cut or bent without the plates themselves having been disturbed or shifted from their bed.

Joints in the low rail on curves naturally tend to "kick" in, and the single-shoulder plate offers only slight resistance to this tendency, with the result that the inside spikes are throat cut and are sometimes bent back a trifle, allowing the rail to shift away from the shoulder. Any inward movement of the rail at the joint affects the line, tightens the gage and induces additional wear on the outer rail opposite the joint.

Double-shoulder tie plates will eliminate these undesirable conditions, so far as the tie plate contributes to them. The inside shoulder protects the inside spike from throat cutting and bending back, thus giving better detailed line and gage. Track equipped with them shows far less tendency to become wavy during hot weather and is much less likely to buckle if raised when the rail is tight. Since the shoulders fit snugly against the flanges of the rail, the plates are held straight during the process of bedding. For the same reason the sluing of the ties

as a result of creeping rail is quickly checked. In fact, any such movement of the tie causes the shoulders of the plates to grip the rail and thus adds to the effectiveness of the anti-creepers. Kinked joints in the low rail on curves are practically eliminated, since the rail cannot move unless the tie plate itself shifts, an event that rarely occurs.

By eliminating the undesirable conditions which have been mentioned, the labor required to maintain line and gage is definitely less, the ties receive less abuse because of reduced spiking, and track conditions are better and more uniform. Therefore, I find no disadvantages but many advantages in double-shoulder tie plates.

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Standardizing Hardware

To what extent can building hardware be standardized? What are the advantages? The disadvantages?

Establish a Distinct Type

By FRANK R. JUDD
Engineer of Buildings, Illinois Central, Chicago

It is good practice to use a selected pattern of finish hardware for buildings of like classification since, although this cannot strictly be termed standardization, it establishes a distinct type of hardware for each class of buildings and proves to be very satisfactory. In the more important buildings this practice can be deviated from by changing the pattern to conform to the particular design that is being developed. In general, a lump sum price can be set up in the specifications providing for the purchase of all of the finish hardware, this price being adjusted later to conform to the actual cost of the hardware. Deviation from this method can be made from time to time in connection with smaller or less important structures where the hardware can be listed on the drawings or in the specifications and thus included in the cost without adjustment. The foregoing methods conform to the specifications recommended by the A.R.E.A. This method of using a selected pattern of hardware on buildings of like classification is an advantage because they can be trimmed alike and there are not so many patterns to duplicate or so many different repair parts to order in connection with maintenance.

This Question Has Never Been Settled

By A. T. HAWK
Engineer of Buildings, Chicago, Rock Island & Pacific, Chicago

Although these questions have been asked ever since I started railway service, I have never reached a definite conclusion, because it is desirable to obtain the best article at the lowest possible cost, at the same time keeping up with the improved designs and better-wearing metals that are constantly being developed. For minor stations and offices, roadway buildings, water and fuel stations, shops and enginehouses, etc., a definite standard is practicable for both construction and maintenance. This requires a close check and observation of the performance of the hardware that has been installed to insure that it is satisfactory.

In the preparation of detailed plans and specifications, care must be exercised to insure that the proper size and kind of metal are shown and that satisfactory provision is made for the lubrication of moving parts, either automatically or manually. It has been found by test that ball bearing butts will give better service, regardless of lubrication; yet lubrication is an important feature in all types of butts and should be provided, not only as an essential part of the design but throughout the life of the hinge by systematic inspection.

It is not always practical to have a cut-and-dried standard, since this eliminates competition in making the purchases. For this reason I generally provide the purchasing department with a list of several equally satisfactory articles, with all essential information for each, from which to secure bids. This permits the purchases to be made most advantageously. As the foregoing indicates, I believe that much of our hardware can be standardized with safety, provided sufficient study is given in making the selection to insure that it will do its duty during the life of the building to which it is applied, and can be purchased at a reasonable price.

The principle advantages of standardizing hardware are that the stores department stock will be reduced to the minimum, the articles can be purchased in lots at lower cost and they can be supplied from stock without the confusion that always attends a multiplicity of designs.

Among the disadvantages, unless there is unrelenting follow-up of the standard plans and frequent systematic inspection of the stock carried, there is a probability of a top-heavy line of some items and a shortage of others. This can be rectified by proper stores supervision, however. Owing to constant improvements in design and manufacture, there is the ever-present hazard of finding the standard obsolete within a year of its adoption. Furthermore, it is not good practice to standardize on an item that has not proved its worth in service, and this may take years. Again, the particular article may become obsolete before its worth has been proved.

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Heaving Track

What action, if any, can the track forces take at this time to minimize heaving during the winter?

Prevent the Accumulation of Water

By J. A. GIVEN
District Engineer, Southern Pacific, Dunsmuir, Cal.

Heaving is always due to the expansive force of freezing water. Where water is not present in the roadbed or ballast, no heaving will occur, although very low temperatures may prevail. For this reason, the cure for heaving is to prevent an accumulation of water. At this time of the year the track forces should see that ditches through cuts are cleaned and that all culverts are opened and that the channels for some distance up and downstream are clear, so that water from rains or melting snow will not accumulate and saturate the roadbed.

Following the first rainstorm of the fall, the section foreman should go over his section, making a minute inspection and noting points where the ballast is not draining freely. He should immediately open up the ballast at these places in such a way that the water will drain off. If this drainage is completed before a freeze sets in, very little heaving will be experienced.

On certain kinds of ballast which do not drain freely, it is often an advantage to dig out the cribs at switch points and at moveable-point and spring frogs, to a depth of one or two inches, so that when the freezing ballast expands it will not obstruct the moving parts. Where this is done, miniature ditches should be constructed to lead the melting-snow water away from the frogs and switches.

Drainage Only Sure Cure

By W. O. FRAME
District Engineer Maintenance of Way, Chicago, Burlington & Quincy, Burlington, Iowa

Since the causes of heaving are quite generally extremely low temperature and the presence of considerable moisture in the roadbed, it follows that the most effective way to eliminate or reduce heaving at this time is to provide the best drainage possible at those points where heaving may be expected. This will include the replacement of foul ballast with clean ballast of good quality. There are places, such as through interlockings, slip switches and around water columns, where it is impossible to maintain good drainage at all times. In such places, heaving can sometimes be prevented by removing the ballast and spreading a heavy layer of coarse salt over the full width and length of the track affected by heaving, after which the ballast should be restored.

A few places will be found where the causes of the heaving are too deep seated to be removed by any action of the local forces, and where the heaving causes considerable labor and expense for shimming, as well as damage to ties from adzing. In such cases much of this labor can be avoided by applying wood shims on the ties at the point where heaving is expected to occur, doing this before the ground begins to freeze. As the heaving progresses, the shims can be removed entirely or replaced with thinner shims as necessary. This permits the lowering of the track to grade to be done quickly and at little expense.

Little Can Be Done at This Time

By W. J. SHAW, JR.
Division Engineer, Michigan Central, St. Thomas, Ont.

It is well known that drainage is the secret of eliminating heaving, and the most important action at this time is to clean out ditches and do such other work as will accelerate the runoff of water from the roadbed. Such work is about all that is practicable when winter has approached so closely.

Soil conditions in the roadbed play a vital part in heaving. In cuts there may be pockets of quicksand or springs. In embankments, water pockets form from various causes. Where these conditions occur, it is evident that the track will heave and that the only remedy is complete drainage. The scheme of drainage will depend, however, on the particular conditions to be eliminated. In cuts, surface drains are important, but as this cares only for surface water, which, although necessary, does not go far enough to eliminate the trouble at its source.

Subsurface drainage by means of pipes of sufficient diameter, placed at such depth as to insure that it will be below the bottoms of the water pockets, is the only permanent cure. Care should also be used to insure that all water coming in from the sides is intercepted and not allowed to reach the roadbed. Complaint is sometimes made that subsurface drainage is not entirely effective. In almost every such instance it will be found that the drain pipe was not placed deep enough, or that it was not laid to a true gradient. The backfilling of the trench is also important, for it is of little use to backfill the trench with the material that was dug out of it. Rather, the backfilling should be porous material, such as locomotive cinders, crushed stone in sizes of 2½ to 3 in., or other material that will allow the water to filter through it.

Subdrainage can sometimes be combined effectively with surface drainage, by installing inlets and catch-basins at frequent intervals to admit water to the tile, provided the tile is of sufficient size to carry both the surface and subsurface waters. In any event, catch-basins should be installed reasonably close together to permit examination of the drain and cleaning if this becomes necessary.

Water pockets in embankments can be treated very simply, by means of French drains or perforated metal pipe. The secret of success in either case is to get below the lowest point of the pocket and use proper material for backfilling. Cinders have been used for backfilling, but because they settle down and compact, they are not as effective as clean crushed stone.

Heaving at road crossings is difficult to control because water gets under the planking and the ballast may be too high under the plank. It can be reduced considerably by drainage, which can be provided by digging a trench about one foot wide across the highway at or very close to the ends of the ties. This trench should extend at least one foot below the ties, should be given as much fall as possible and should be filled with clean crushed stone. The ballast should be kept well below the planks to provide space for snow, which may be crowded under the crossing by passing trains and vehicles.

Heaving at pipe culverts is caused in large measure by the cold air in the pipes. At smaller culverts, this condition can be relieved in some degree by blocking with snow, or in other ways those that do not ordinarily take running water. Extreme caution should be observed to open them up, however, when freshets or heavy rains occur. Clean ballast is of the utmost importance in the prevention of heaving, since the drainage of the track itself is thereby assured.

Correction Should Be Made Early

By ROBERT WHITE
Section Foreman, Grand Trunk Western, Drayton Plains, Mich.

Correction of defective drainage is the only permanent cure for heaving. If this has not been attended to, there is little that the section forces can do to reduce heaving when winter is almost at hand. If drainage is ample and effective, there is little that they need to do. The local forces have no control over the major work that is necessary to provide the needed drainage where heaving is troublesome and of long standing, any more than they have over the severity of the weather, which is also an important factor in heaving.

It is true that effective surface drainage will be of help, for which reason all ditches should be open and effective at all times to insure that they will remove as much water as their function will permit. I have observed, however, that even where ditches are working properly, heaving will occur because the source of the trouble is located deep within the roadbed. I have observed also that heaving is generally more pronounced around road crossings, switches, etc., if salt is used than if it is not. I have removed the ballast from the cribs, placed salt and then restored the ballast without improving conditions, because the effect of the salt does not reach to the water pockets or the saturated clay which is the source of the trouble.

I have a mile of track through a yard which is low and poorly drained. Yet when this track heaves, it gives less trouble than some high well-drained track that I know of. The reason for this is that it heaves evenly for long stretches, making it necessary to apply shims only at the ends of the heaved spots. On the other hand, heaving on well drained track is likely to occur over a limited distance, sometimes only two or three ties are involved, but at short intervals, making it necessary sometimes to

shim the track continuously over many rail lengths.

This is not said hopelessly or with the idea that drainage is unimportant, because defective drainage is at the seat of every case of heaving. Perfectly dry roadbed never heaves. I merely wish to emphasize that proper and adequate drainage of water pockets or saturated roadbed is generally beyond the capacity of the local forces and that if drainage has not been provided, there is little left for the section forces to do at this time other than to get their shims ready to use when needed.

Water Is Worst Enemy

By W. H. SPARKS

General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

Water is the worst enemy of the track, regardless of the season of the year. In the winter, one of its manifestations is the heaving of the track. Drainage is the only cure for heaving, but major drainage projects can seldom be undertaken when winter is close at hand, while they are generally beyond the resources of the local maintenance forces. It remains, therefore, for these forces to do only minor things at this time, which will improve drainage. These include the cleaning of surface ditches that are not functioning properly; the cleaning of the ballast shoulder where needed to permit free drainage, although not very much of this can be done this late in the season; and the cleaning of foul ballast from farm and highway grade crossings. It is sometimes possible to reduce heaving by cutting an intercepting ditch along the top of a cut and thus lead the water away from the roadbed. Any section has one or more of these jobs and sometimes others of like character which can be taken care of at this time, but in general, I favor having such work done much earlier, since few such conditions occur as emergencies but are known to exist long before the approach of winter. In fact, conditions at other seasons will be improved if these defects are bad enough to require correction when winter is just at hand.

Make Final Arrangements for Drainage

By HENRY BECKER

Section Foreman, St. Louis-San Francisco, Rush Tower, Mo.

I have always found it desirable to go over the section just prior to winter and clean up a number of small jobs. These include the cleaning of the ballast from the cribs at switch points to allow proper clearance of the moving parts; the removal of and cleaning of the ballast in the cribs at road crossings; and the perfection of the drainage at points where water may accumulate. If the cribs at switches are not cleaned, it may be expected that the rods will eventually be riding on frozen ballast, which will interfere with their operation if it does not create a distinctly dangerous condition. Likewise, by cutting down the ballast in the cribs under crossing plank, the probability of the plank being forced up by frost and packed snow, is greatly reduced. The purpose of perfecting drainage is obvious; and in many instances is all that is needed to prevent heaving.

Keep Ballast Shoulders Clean

By A. G. SAUNDERS

Section Foreman, Chesapeake & Ohio, Marion, Ohio

In my experience, track is more likely to heave at road crossings and over shallow culverts than elsewhere. It may be expected also that the track will heave where the ballast is dirty or for some other reason does not drain freely. If this has not already been done, it is important that the section forces clean the shoulder of the dirty ballast, replacing it if possible with clean material, to provide better track drainage. Likewise any dirty ballast in road crossings should be dug out and replaced with clean material.

Much can be done to minimize the effect of heaving if, when trimming the ballast shoulder, especially where the track has been raised, the shoulder is made uniform and not too wide. I have observed that where track heaves, the heaving is more severe where the shoulder is quite heavy. Again, on double track, I have seen the track shoved out of line where the intertrack space was filled completely full with ballast.

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Hardwood or Softwood Tie Plugs

Should hardwood or softwood tie plugs be used with softwood ties? With hardwood ties? Why?

Favors Softwood Tie Plugs for Both

By W. H. SPARKS

General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

We are enforcing our instructions with respect to plugging spike holes more rigidly today than ever before. Two reasons are involved for doing this, (1) a desire to fill the old hole in such a way as to exclude, so far as possible, any chance of water entering the space around the spike, and (2) to increase the holding power of the redriven spike. It has been my observation that either type of plug will perform these functions. Observation indicates, however, that the softwood plug splits and opens up more readily than the hardwood plug as the spike is driven, thus making it somewhat easier to drive the spike in the desired position. At the same time it seems to develop a better grip on the spike, and is more readily pressed into any irregularities in the old hole. For these reasons, I prefer softwood tie plugs for both hardwood and softwood ties.

All Plugs Should Be of Same Kind

By Division Engineer

Although this point is not raised in the question, it is well to emphasize that there are several essential reasons why the use of tie plugs should be made mandatory, as it is on most roads. It is equally important that the proper materials be selected for the manufacture of the plugs, and that they be given a preservative treatment that will insure complete penetration of the wood and that they be "dry" when delivered. While the terms softwood and hardwood are somewhat confusing, in that some of the woods which are given the former classification are harder than some of the latter, it is my experience that, in general, the softer woods, regardless of classification, are more suitable for tie plugs than those of the harder varieties.

As a rule, the softwoods split more easily, they fill the spike hole better, take a firmer grip on the spike and, because of their greater compressibility, are less likely to split the tie. Before ties were prebored, any kind of a plug could be expected to remain in place while the spike was being driven. Today, with prebored holes that extend clear through the tie, a plug that will not split may be pushed ahead of the spike some distance, despite the widened shoulder. In fact, I have seen several cases where the shoulder sheared off and allowed the plug to be driven ahead of the spike for almost its entire length.

Aside from these features, there is also the practical consideration that most roads are using both hardwood and softwood ties and that in only a few cases are the two types completely segregated. For this reason, every section is likely to have some ties of each kind. In many cases, the only separation that is made is the selection of hardwood ties for use at joints and on curves, the remainder being more or less mixed in the track. It would be difficult, if not impracticable in such cases, if two kinds of tie plugs were provided, to insure that the hardwood and softwood plugs would be used with the respective hardwood and softwood ties. Taking all of these facts into consideration, it is my judgment that softwood tie plugs should be used exclusively.

Hardwood Plugs Damage Softwood Ties

By HENRY BECKER
Section Foreman, St. Louis-San Francisco, Rush Tower, Mo.

In my judgment, a hardwood tie plug should not be used in a softwood tie since the hard wood is more resistant to compression, for which reason it tends to enlarge the spike hole. Eventually, this will result in the seepage of water into the hole and decay in the damaged wood fibres along the wall of the hole. On the other hand, if a hardwood plug is used in a hardwood tie, it will encounter wood of substantially the same hardness and the hole will not be enlarged but will be well sealed against the entrance of water. These same conditions will obtain when a softwood plug is used in a softwood tie. For these reasons, I believe that the best practice is to use softwood plugs in softwood ties and hardwood plugs in hardwood ties.

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Pulling Drift Bolts

Where drift bolts cannot be pulled from stringers or caps with a claw bar, what other means can be employed to remove them without damaging the timber?

Saws the Bolt Between Stringer and Cap

By Supervisor of Bridges and Buildings

It was formerly our custom, when drift bolts could not be removed from untreated timber with a claw bar, to saw the stringer just outside the limits of the cap and split the cut-off end containing the drift bolt. Timber is too valuable today to permit such a practice. I have tried a number of expedients in trying to solve this problem, the most successful of which is to lift the stringer, with jacks if necessary, and saw the bolt between the stringer and the cap, using a hack saw for this purpose. This method has the advantage that the timber is not damaged. Of course, if the drift bolt must be replaced, there is an extra hole in the end of the timber. This can be avoided, however, by attaching the stringer to the cap by means of an angle plate bolted to both the stringer and the cap.

Drift Bolts Should Not Be Used in Stringers

By General Inspector of Bridges

I consider it poor practice to attach a stringer to a cap by means of a drift bolt, although this method was followed in building many of our older structures. In my experience, it rarely happens that a drift bolt cannot be removed with a claw bar, even where it seems to be hopelessly tight, if it is tapped two or three times with a sledge, using sufficient force to remove rust scale and break the grip of the wood fibre. In the event that this does not loosen the bolt sufficiently to make its removal with a claw bar practicable, the best method is to use a shackle, making very sure, however, that there is no chance for slippage if the bolt proves to be unusually refractory. In extreme cases, the stringer should be raised enough to allow the bolt to be cut off between the stringer and the cap. I would consider this as a last resort because of the expense involved. Drift bolts should be removed from caps in the same manner.

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Triplex Pumps

What are the advantages of triplex pumps as compared with duplex-reciprocating and centrifugal pumps for railway water service? For what conditions are they particularly adapted?

Duplex and Triplex Pumps Are Self-Priming

By E. M. GRIME
Engineer of Water Service, Northern Pacific, St. Paul, Minn.

The single-acting triplex pump with three impulses to its cycle has the advantage of giving a more uniform flow through the pipe lines and less strain on valves and piping than the duplex-reciprocating type. Some years ago, the triplex pump had the advantage of higher efficiency, but with recent advances in the design of centrifugal pumps the triplex is being rapidly displaced by the centrifugal type. The latter has the advantages of light weight and small-space requirements, while the cost has been reduced to the point where a centrifugal pump with motor drive can sometimes be installed at no more expense than is required for overhauling a triplex pump that has been in service for some years. At the same time, the motor-driven centrifugal pump may have a higher efficiency.

Where there are large fluctuations in the water level, it is often practicable to install triplex pumps with extended piston rods. By this arrangement the power end of the pump is located on the floor or platform above high water and the plungers are down in the well below low water. In this way, a higher suction lift can be utilized than would be possible with the ordinary duplex-reciprocating pump. Here again, the triplex pump is giving way to the turbine type of centrifugal pump for new installations where there is a large variation in the head, and usually at less cost. For years the duplex pump has practically been the standard for boiler feed purposes, but even in this field the centrifugal type is now slowly superseding it.

The centrifugal pump has definite limitations with respect to head, and its efficiency drops when the suction lift much exceeds 15 ft. On the other hand, a plunger pump can start with a suction lift of 15 ft. and will perform satisfactorily at lifts up to 25 and 27 ft. This fact gives duplex and triplex pumps an advantage in certain locations where, for some reason, the pump cannot be located at a suitable distance above the water level to fit the suction requirement of the centrifugal pump.

One important advantage of both the duplex and triplex types is that they will practically prime themselves by reason of the positive displacement of the plungers, whereas the centrifugal type must always have some source from which water will fill the impeller spaces and force out the air.

Conditions of Service Determine Advantages

By C. J. CLARK
Cameron Pump Division, Ingersoll-Rand Company, New York

For any application where pumps are required, whether for railway water service, general service in buildings, boiler feed purposes, etc., several things must be taken into consideration. Most important among these are: (1) The type of installation must be determined, that is, whether the installation is to be automatic, with periodic inspections, or manually operated, with an attendant constantly present; and (2) the capacity and total head must be known as these factors will determine whether a centrifugal, duplex or triplex pump shall be used in a particular location.

Where the required capacity is less than 100 gal. per minute and the head is more than 100 ft., it is advisable to use a triplex pump, since this type gives a relatively smoother flow of water through the pipe lines, with less tendency for water hammer, than the duplex unit. Where the head is less than 100 ft. and the required capacity is not greater than 75 gal. per minute, a duplex pumping unit will be preferable to either the triplex or centrifugal type.

When the capacity for lower heads is greater than 75 gal. per minute, a self-priming centrifugal pump will provide reliable operation for automatic installations. This is also true for capacities greater than 100 gal. a minute and heads greater than 100 ft. There are now available on the market various types of self-priming equipment which can be applied to standard centrifugal pumping units, assuring continuous operation.

In manually operated stations, where an attendant is always available, it is usually advantageous to use centrifugal pumps, since the initial cost of these units is low, the floor-space requirements are small and the efficiencies of modern units are relatively high. As compared with duplex and triplex pumps, maintenance costs are much lower for centrifugal pumps. This applies not only to the pump itself, but to the valves and other pipe fittings as well, because shocks and water hammer are eliminated through the use of centrifugal pumps.

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Waterproofing Failures

What are the causes of failure in built-up waterproofing? What can be done to eliminate or minimize these failures?

Flashing Details Often Cause

By G. A. HAGGANDER
Bridge Engineer, Chicago, Burlington & Quincy, Chicago

One of the main causes of failure of waterproofing is the lack of attention paid to the flashing details, or the connection of the waterprpofing to the structure at the edges of the blanket. If these details are not well designed, it is quite likely that water will get under the blanket and cause leakage at some point that is supposed to be protected. Other failures can be attributed to poor expansion-joint design or construction, to cracks caused by settlement of the structure, to decay of the fabric and to poor workmanship in application. I consider the best design of an expansion joint to be one in which the surface to be waterproofed is raised at the joint to form a dam and thus reduce the amount of water falling on or passing over the joint.

Cracks resulting from settlement are difficult to control. Some allowance for movement can be made by folding the fabric in such a way that it can elongate at the points where trouble is expected. The former practice was to use untreated burlap as the reinforcing material of the waterproofing. It was difficult to saturate this material thoroughly, with the result that much of it decayed and ruined the efficiency of the waterproofing. This has been overcome by the use of cotton fabric and felt, both of which can be thoroughly saturated at the point of manufacture.

Even with the best of materials and details of design, there are two points that must be watched carefully. The first is connected with the design of the structure, which should provide for proper slopes and facilities for drainage. If the surface to be waterproofed is on a slope which will allow the water to pass off quickly, the chances for leakage through the waterproofing are very much reduced. The second matter, which should be given a great deal of consideration, is that of workmanship. Regardless of the class of material used, of the type of details employed to provide proper drainage or of any other phase of design, laxity in the supervision of the application is quite certain to make all other precautions ineffective in producing a good job.

Failures Traceable to Three Sources

By M. HIRSCHTHAL
Concrete Engineer, Delaware, Lackawanna & Western, Hoboken, N. J.

Failures of built-up waterproofing are traceable to three sources. The first of these is either the material itself or the design; the second refers to the method of application; and the third is construction subsequent to the original application of the waterproofing.

Failures may be caused by the use of inferior or unsuitable material, such as bitumen that does not have the proper ductility within the required temperature range and becomes brittle and cracks. Or they may be due to reinforcing material that does not have sufficient tensile strength to resist the stresses caused by temperature changes. In design, failure to provide expansion joints where they are necessary or to provide for the movement of the waterproofing as well as of the material of construction are fertile causes of failure. An ineffective protection coat on a bridge floor may permit the waterproofing to be punctured by the ballast.

Failures of the second class may be due to faulty or lax methods of application. These include failure to flash properly at junctions with inclined or vertical surfaces or around pipes and other drainage openings in such a way as to seal the contact edges and thus prevent the entrance of water, which will invariably work its way under the built-up waterproofing. Another source of trouble is the carelessness of laborers in dropping tools on the waterproofing before the protection coat is placed. The writer witnessed such an occurrence recently, finding a crowbar which had been dropped by a laborer and which had completely pierced the waterproofing blanket. In the meantime, the laborer had gone elsewhere to do other work without a glance at the damage he had done. If this spot had not been noticed and repaired, it would have resulted in a leak.

Construction subsequent to the application of the waterproofing is the third cause of failure. A typical example is that of a platform or other curb wall, which may be constructed directly on the waterproofing, without an intervening protection coat. In such a case sharp stones in the aggregate may pierce the waterproofing, or where dowels project through the blanket, sufficient care may not be used to insure that the contact edges are properly sealed.

What Our Readers Think

Dapping Bridge Ties on Curves

St. Paul, Minn.

To the EDITOR:

The description of the Northern Pacific's new standard pile trestle, which appeared on page 542 of your October issue, made no reference to one distinctive feature of our practice in pile trestle construction. As noted on the plan appearing in this article, the ties are 8 in. by 8 in., but on all of our trestles on curves of two degrees or more we use an 8-in. by 10-in. timber, dapped over the stringer, for every fourth tie.

This is done to provide greater resistance to centrifugal force than is afforded by bolting the ties to the stringers. We once had a bad derailment of a passenger train that had exceeded the limit of restricted speed on a curve, and it was determined by analysis that the deck had actually slipped laterally on the stringers in spite of the resistance offered by the bolts provided in accordance with our standard plan. I believe the Northern Pacific is the only railroad that provides this additional fastening between ties and stringers on pile trestles.

M. F. CLEMENTS,
Bridge Engineer, Northern Pacific.

High Speed Trains and the Track Structure

Pittsfield, Mass.

To the Editor:

If the new high-speed, light weight trains that are now coming into use are to be successful and safe, and the new form of service afforded is to be satisfactory and commercially worthwhile, it is important that the tracks over which these trains operate be practically perfect in every respect and be constantly so maintained. This is true particularly with regard to the rail joints, an element of the track structure which has always been more or less difficult to maintain in satisfactory condition. Even when reasonably well maintained, it is difficult to keep the joint bolts tight and the rail ends from becoming more or less battered by the action of the wheels.

Uniform evenness of the running surface of the rail is of great importance in train braking, and particularly so in emergency braking where the brake apparatus functions solely as a safety device. It is well known that when the brakes are applied, their retarding effectiveness is dependent upon the frictional resistance created between the wheel treads and the rails at the contact points, just as much as upon the friction between the brake shoes and the wheel treads. It is quite plain, therefore, that in brake applications, both the brake shoes and the tread surface of the rail must act simultaneously and continuously upon the rotating wheel tread while the brake remains applied, if the maximum rate of train retardation is to be realized.

The brake shoes will, of course, remain constantly against the wheels so long as the application is held on, but unless the rail surfaces are uniformly even and parallel, the rails well supported and the track entirely free from a center-bound condition and from poorly maintained rail joints, the wheel and rail contacts will be broken by the motion of translation of the wheels. In other words, the wheel and rail contact will be intermittent during the period of train braking. Uneven track surface is very conducive to injurious wheel sliding, and results in a rate of retardation considerably below that which is attainable on track in proper surface.

JOHN P. KELLY.

New Device

Develops New Process for Zinc-Coating Wire

THE Bethlehem Steel Company has developed at its plant at Sparrows Point, Md., a new type of zinc-coated wire, known as Bethanized wire, on which the coating is said to be so ductile and tightly adherent to the steel base that it will not crack, flake or chip off under the most severe distortion. The process for coating this wire is electrolytic, the metal being deposited on the wire from a liquid solution. Wire coated with zinc in this manner is applicable for use in railroad service in right-of-way fence, telephone and telegraph lines, signal bonds, etc.

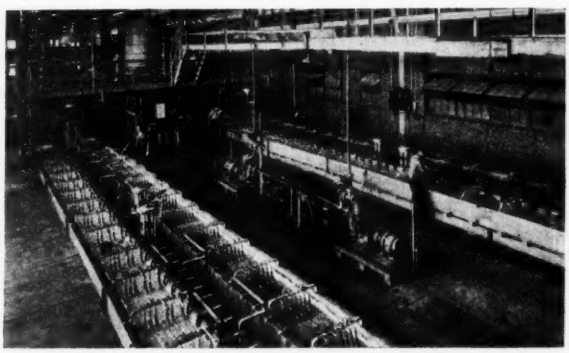


Photo by courtesy of Bethlehem Steel Co.

The Electrolytic Cells in Which Wire Is Coated With Zinc in the Bethanizing Process

The zinc coating is applied in electrolytic cells, 55 ft. in length, lined with lead and provided with anodes in the form of strips which extend the full length of the cell and divide it into compartments, through each of which a single wire is drawn. Current flows through the plating solution to the wires and is taken off the wires by means of contacts spaced at regular intervals. The cells now in operation are supplied with direct current from a 250 kw. motor generator set at 20 volts. The current density ranges from 700 to 1,400 amp. per square foot. While there is said to be no limit to the thickness of zinc that can be applied to wire by this process, three grades have been set as standard for the present, the minimum thicknesses being such as to require 0.8, 1.6 and 2.4 oz. of zinc, respectively, per square foot. Bethanized wire ranging from 6 to 16 gage is now being manufactured regularly.

In preparing the zinc for the Bethanizing process, the roasted ore, containing about 65 per cent zinc, is weighed and placed in leaching tanks containing a specified concentration of sulphuric acid. This mixture is then filtered to remove impurities, after which the liquid is pumped into a storage reservoir.

Wire is prepared for the process by passing it through a lead annealing bath, after which it is cleaned by a double electrolytic cleaning process.

News of the Month . . .

Western Lines to Air-Condition 2,500 Cars for 1935

A program calling for the air-conditioning of 2,500 passenger cars for the 1935 summer season has been agreed upon by 21 western and southwestern railroads. While the program undertaken last year was confined to the installation of air-conditioning equipment in dining, cafe and club lounge, observation and room cars, the restrictions agreed upon by western carriers last year have been removed so that entire trains, including coaches, chair cars, parlor cars, sleeping cars, lounge cars, observation cars and dining cars, will be air-conditioned. Every through train of importance which is operated in western territory will be air-conditioned throughout.

Zephyr Makes First Scheduled Run on November 11

The Zephyr of the Chicago, Burlington & Quincy made its first run in regular service between Lincoln, Neb., and Kansas City, Mo., on November 11. On its initial trip southbound it carried more than 100 persons, the demand for space being so great that reservations were closed several days in advance. The first run was accompanied by appropriate ceremonies at Lincoln, Omaha, St. Joseph and Kansas City, in which the objective was to illustrate the progress that has been made in transportation by comparing the Zephyr with older forms of transport, such as the covered wagon and the pony express.

The demand for space is significant in view of the fact that the Burlington, in order to satisfy the curiosity of persons along the line and thus reduce the number desiring to ride the train on November 11, operated 42 round-trip excursions, of about one hour's duration each, out of the more important cities along the route during the week of November 3-10. A total of 1,169 persons were handled by the train on these excursions.

Asks that Police Court Status of Railroads Be Dropped

Milton W. Harrison, president of the Security Owners Association, in a recent address, advocated an abandonment of the "police court" status of the rail carriers and suggested the immediate formulation of a natural transportation policy to deal with the present crisis. He declared that restrictions of rail "blue laws," plus the cumbersome machinery of government regulation, have brought the railroads to the verge of bankruptcy. "In the years since 1906," Mr. Harrison said, "when the Hepburn Act was passed, regulation of the carriers has grown so that today a railroad president scarcely dares call his soul his own without consulting the Interstate Commerce Commission. It has grown to occupy the complete attention of a commission of eleven members, a staff of more than 600 persons, and an annual expenditure of more than $10,000,000. The railroads may 'bleed to death' financially, as they are doing at the present time, but the doctor will not arrive, no matter how serious the emergency, until many months, possibly, after the crisis."

Federal Relief Corporation Ships 146,977 Revenue Cars of Freight

During the year ended September 30, the railroads handled 146,977 carloads of revenue freight for the Federal Surplus Relief Corporation, according to Harry L. Hopkins, Federal Relief Administrator, and president of the corporation. The livestock, foodstuffs, and other commodities shipped by the F.S.R.C. to state relief administration for distribution to the needy unemployed, if shipped at one time, would have required one movement of 2,935 trains of 50 freight cars each.

Large Locomotive Orders

Two record-breaking orders for locomotives have been placed in recent weeks. Orders for 57 streamlined electric locomotives, the most powerful electric passenger locomotives ever to be built, have been placed by the Pennsylvania. These locomotives, which will cost a total of nearly $15,000,000, have been especially designed for this road's high-speed passenger service to be inaugurated between New York, Philadelphia, Pa., Baltimore, Md., and Washington, D. C., early in 1935. They will be capable of hauling standard-size trains at a regular operating speed of 90 miles an hour.

One of the largest orders ever placed for Diesel-electric locomotives has been let by the Illinois Central, the amount involved being 11 locomotives costing a total of $1,200,000. These locomotives, 3 of which will be transfer locomotives and 8 switching locomotives, will replace steam locomotives for handling freight trains within the city limits of Chicago.

Rail Income Up for Nine Months; Down for September

For the first nine months of 1934 the Class I railroads of the country had a net railway operating income of $342,609,842, which was at the annual rate of return of 1.80 per cent on their property investment, as compared with a net of $341,457,795, or 1.78 per cent, in the same period of 1933, according to figures compiled by the Bureau of Railway Economics. Operating revenues for the first nine months totaled $2,464,070,761, as compared with $2,298,236,307 for the same period in 1933, an increase of 7.2 per cent. Operating expenses for the nine months amounted to $1,836,277,444, as against $1,665,882,164, for the same period in 1933, an increase of 10.2 per cent.

In September the Class I railroads had a net of $41,020,484, or 1.34 per cent on their investment, as compared with $60,608,883, or 1.97 per cent, in September, 1933. Operating revenues for September amounted to $275,510,715, as against $292,158,838 in the same month of 1933, a decrease of 5.7 per cent. Operating expenses in September totaled $203,800,353, as compared with $199,434,706 in the same month of 1933, an increase of 2.2 per cent.

R.F.C. Loans to Railroads Again Increasing After Lag

While loans to railroads from the Reconstruction Finance Corporation fell off sharply during the first half of 1934, they are again showing a tendency to increase. In 1932 the R.F.C. loaned to railroads a net amount of about $280,000,000, in 1933 the net addition to the railroad loans outstanding was $57,000,000, and this year, up to September 30, the net total increased only about $6,000,000. Recently however, the Interstate Commerce Commission has made the necessary findings authorizing additional loans of $6,000,000 to the New York, New Haven & Hartford; $7,357,000 and $4,318,000 to the Chicago & North Western; and $3,000,000 to the Lehigh Valley. In addition, the commission now has pending applications for loans of $9,000,000 to the Chicago, Milwaukee, St. Paul & Pacific; $3,102,150 to the Denver & Rio Grande Western; and $4,000,000 to the Illinois Central.

Up to October 31, according to its latest report, the R.F.C. had authorized loans to railroads amounting to $442,994,930, of which $423,801,021 had been disbursed and $70,631,455 had been repaid.

R. B. A. Appeals for More Grade Elimination Funds

In a recent appeal to the Public Works Administration, the Railway Business Association, through its president, Harry A. Wheeler, made a strong plea for the spending of further large sums for the elimination of grade crossings as a means of providing large scale employment and reducing accidents. "The administration," said Mr. Wheeler, "is now developing its program for relief expenditures during the coming year. Considering the magnitude of the operation, it is imperative that the maximum value be obtained for the money spent. To that end, the Railway Business Association is again earnestly asking the public works and relief administrations to allocate funds for the elimination of railroad grade crossings as a make-work measure and as a step toward the reduction of the gigantic toll of human life taken in this age of speed." He then called attention to the huge amounts that the railroads have been forced to spend for grade crossing elimination in the past, and declared that the use of public funds for this purpose would provide some measure of relief for the railways.

Personal Mention

General

N. M. Lawrence, division engineer on the Philadelphia Terminal division of the Pennsylvania, with headquarters at Philadelphia, Pa., has been promoted to superintendent of the Erie & Ashtabula division.

H. J. McCall, trainmaster-roadmaster on the Northern Pacific, with headquarters at Mandan, N. D., has been promoted to assistant superintendent in charge of maintenance of the Superior division, with headquarters at Duluth, Minn.

James Buckelew, general superintendent of telegraph of the Eastern region of the Pennsylvania, who served for many years in the engineering and maintenance of way departments of this company, has retired.

T. C. Macnabb, engineer of construction of the Western lines of the Canadian Pacific, with headquarters at Winnipeg, Man., has been appointed general superintendent of the New Brunswick district, with headquarters at St. John, N. B. Mr. Macnabb was born at Toronto and entered the service of the Canadian Pacific in the freight department at Brandon, Man., being transferred to the engineering department at Winnipeg as a draftsman in 1902. In 1903 he was stationed at Field, B. C., and a year later as resident engineer at

T. C. Macnabb

Lacombe, Alta., holding the same position also at Saskatoon, Sask., Lethbridge, Alta., and Battle River in succession. In 1908, Mr. Macnabb became assistant engineer of construction between Lanigan, Sask., and Prince Albert, and held that position at Weyburn, Sask., and Regina for six years. In 1915 he became division engineer at Moose Jaw, Sask., and two years later he was made division superintendent of the Revelstoke division. Mr. Macnabb was appointed superintendent of construction of the Western Lines in 1926. He is regarded as a pioneer in railway surveying from the air, and was the first engineer to survey the Great Bear district from northwestern Canada to the Rockies from the air.

Chester T. Dike, chief engineer of the Chicago & North Western, has been appointed vice-president and chief engineer in charge of maintenance of way and structures, with headquarters as before at Chicago. He has also been appointed vice president in charge of maintenance of way and structures of the Chicago, St. Paul, Minneapolis & Omaha, a subsidiary of the North Western. Mr. Dike has been connected with the North Western continuously for 36 years. He was born on August 13, 1871, at Woodstock, Ill., and was educated at Cornell College, Mt. Vernon,

Chester T. Dike

Iowa. Mr. Dike entered railway service in April, 1890, as a chainman on the Northern Pacific, and in 1896 he was appointed chief engineer of the Mason City & Clear Lake, at Mason City, Iowa. Two years later he went with the Iowa, Minnesota & Northwestern (now part of the C. & N. W.) as chief engineer, and from 1899 to 1901 he served as resident engineer on the North Western in charge of the location and construction of the I. M. & N. W. From the end of this period until 1902, Mr. Dike served in a similar position on the Peoria & North Western and the Verdigre extension of the North Western. In 1903 he was appointed division engineer on the C. & N. W., serving in this position and as resident engineer in charge of the location and construction of various branch lines until 1907, when he was appointed superintendent of the Pierre, Rapid City & North Western (part of the C. & N. W.). During 1909 and 1910, he served as engineer and superintendent of construction of various new line projects of the North Western; including the Belle Fourche Valley and the James River Valley. In 1911, Mr. Dike was promoted to general superintendent of the Minnesota and Dakota divisions, with headquarters at Huron, S. D., and, during federal control of the railroads, he served successively as assistant general superintendent at Boone, Iowa, and assistant general manager at Omaha, Neb. In 1920, following the termination of federal control, Mr. Dike was appointed engineer of maintenance and in 1931 he was appointed chief engineer, which position he held until his recent appointment.

Robert E. Mattson, roadmaster on the Northern Pacific, with headquarters at Lester, Wash., has been promoted to superintendent of operation of the Northern Pacific Transport Company (motor truck operating subsidiary of the Northern Pacific), with headquarters at Billings, Mont. Mr. Mattson was born on March 24, 1901, at Minneapolis, Minn., and was educated at the United States Naval Academy and Massachusetts Institute of Technology. He entered railway service in August, 1926, as a track apprentice on the Northern Pacific, at Duluth, Minn. In April of the following year he was advanced to assistant roadmaster, with the same headquarters, and in December, 1927, he was appointed assistant supervisor of bridges and buildings, with headquarters at Fargo, N. D. In April, 1930, Mr. Mattson was further advanced to roadmaster at Fargo, and later served in this position at Mandan, N. D., and Lester, Wash., being located at the latter point at the time of his recent appointment as superintendent of operation of the Northern Pacific Transport Company.

J. C. White, superintendent of the Philadelphia Terminal division of the Pennsylvania, whose railway experience includes many years in the engineering and maintenance of way departments of this company, has been promoted to superintendent of freight transportation of the Eastern region, with headquarters at Philadelphia, Pa. Mr. White was born in Huntingdon, Pa., on June 9, 1888, and was graduated from Pennsylvania State College. He entered the service of the Pennsylvania as a chainman in the division engineer's office at Tyrone, Pa., in June, 1912. After serving in this position and as a rodman and draftsman, he was promoted to assistant supervisor, in which capacity he served from May, 1917, to November, 1919, on several divisions. At the end of this period Mr. White was assigned to the Maryland division as assistant master carpenter. In March, 1921, he was appointed assistant supervisor on the Philadelphia Terminal division and in May, 1922, he was transferred to the Baltimore division. In July, 1922, he was promoted to track supervisor and served in this position on the Schuylkill and Middle divisions until January, 1928, when he was promoted to division engineer, which position he held on the Richmond, Logansport and New York divisions. Mr. White next served consecutively as superintendent of the Monongahela division at Uniontown, Pa., of the St. Louis division at Terre Haute, Ind., and of the Eastern division at Pittsburgh, Pa. In July, 1933, he became superintendent of the Philadelphia Terminal division.

Engineering

W. C. Perkins, whose appointment as division engineer of the Kansas division of the Union Pacific, with headquarters at Kansas City, Mo., was recorded in the October issue, was born on December 20, 1888, at Soldier, Ida. He was educated in civil engineering at the Universty of Idaho and entered railway service on September 21, 1916, in the engineering department of the Oregon Short Line (part of the Union Pacific System), with headquarters at Pocatello, Idaho. In

the following year Mr. Perkins enlisted with the United States Twenty-third Engineers, and served overseas. Following the war he returned to railroad service with the Union Pacific, as assistant roadmaster on the Montana division, where he was later promoted to roadmaster. Subsequently he was promoted to division engineer of the same division, then being transferred to the Utah division. On August 18, 1931, Mr. Perkins was appointed roadmaster of the Utah division, and on May 25, 1932, he was advanced to division engineer of the Kansas division. From January 1, 1933, to August 10, 1934, he served as roadmaster and general roadmaster on the Oregon Short Line, holding the latter position, with headquarters at Pocatello, Ida., at the time of his recent appointment as division engineer of the Kansas division in which position his headquarters are located at Kansas City.

Changes on the Pennsylvania

J. M. Fair, division engineer on the New York zone of the Pennsylvania, with headquarters at Jamaica, L.I., New York, has been promoted to engineer maintenance of way of the Western Pennsylvania division at Pittsburgh, Pa., succeeding **S. L. Church,** deceased. **J. E. Vandling,** supervisor of track on the Pittsburgh division, with headquarters at Derry, Pa., has been promoted to division engineer of the Delmarva division, with headquarters at Cape Charles, Va., succeeding **W. R. Parvin,** who has been transferred to the Chicago Terminal division, with headquarters at Chicago. Mr. Parvin replaces **E. O. Wood,** who has been transferred to the Indianapolis division, with headquarters at Indianapolis, Ind., succeeding **R. H. Crew,** who has been transferred to the St. Louis division, with headquarters at Terre Haute, Ind. Mr. Crew replaces **D. Davis, Jr.,** who has been transferred to Jamaica, L. I., to succeed Mr. Fair. **P. E. Feucht,** division engineer of the Renovo division, with headquarters at Erie, Pa., has been transferred to the Fort Wayne division, with headquarters at Fort Wayne, Ind., succeeding **J. S. Gillum,** who has been transferred to the Pittsburgh division, at Pittsburgh, Pa., replacing **Samuel R. Hursh,** whose promotion to superintendent of the Wilkes Barre division, with headquarters at Sunbury, Pa., was noted in the November issue. **L. E. Gingerich,** supervistor on the Baltimore division of the Pennsylvania, with headquarters at Baltimore, Md., has been promoted to assistant division engineer on the New York division, with headquarters at Jersey City, N.J. **W. D. Supplee,** division engineer on the Buffalo division, with headquarters at Buffalo, N. Y., has been transferred to the Philadelphia Terminal division, with headquarters at Philadelphia, Pa., to succeed **N. M. Lawrence,** who has been appointed superintendent as noted elsewhere in these columns.

Mr. Fair was born at Carlisle, Pa., on September 21, 1886, and received his higher education at Lehigh University, from which he was graduated in 1908 with the degree of C. E. He entered railway service with the Pennsylvania on April 1, 1910, as a rodman at Philadelphia, Pa., and, after holding this position at various points, he was appointed transitman on February 1, 1915. On October 7 of the same year he was advanced to assistant supervisor of track on the Baltimore division, with headquarters at Baltimore, Md., and on August 10 of the following year he was transferred to the office of the engineer maintenance of way at Philadelphia. On May 1, 1920, Mr. Fair was promoted to supervisor on the staff of the chief engineer, and on July 15, 1924, he became a division supervisor on the Cumberland Valley division. He was

J. M. Fair

transferred to the Philadelphia Terminal division on August 16, 1926, and on January 10, 1927, he was appointed to the staff of the general manager of the Eastern region, with headquarters at Philadelphia. On January 1 of the following year he was made division engineer of the Buffalo division, with headquarters at Buffalo, being transferred to the Long Island division, wth headquarters at Jamaica, N. Y., on February 1, 1930. He was holding the latter position at the time of his recent promotion to engineer maintenance of way of the Western Pennsylvania division, at Pittsburgh, Pa.

Mr. Vandling was born on August 11, 1899, at Sunbury, Pa., and received his higher education at Pennsylvania State College. He entered railway service with the Pennsylvania as a rodman in December, 1922, and, on May 5, 1924, was appointed acting assistant supervisor of track. On July 1, 1925, he was promoted to assistant supervisor of track, and on May 7, 1927, he was advanced to supervisor of track, the position he was holding at the time of his recent promotion to division engineer.

Track

J. R. Kelly, assistant to roadmaster on the Southern, with headquarters at Somerset, Ky., has been appointed supervisor of track, with headquarters at Dayton, Tenn., succeeding **G. Kidd,** deceased.

H. Olson, a section foreman on the Canadian Pacific, with headquarters at Midnapore, Alta., has been promoted to roadmaster with headquarters at Aldersyde, Alta., to replace **E. A. Kelly,** who has been granted an extended leave of absence. **A. Tronrud,** a track foreman with headquarters at Assiniboia, Sask., has been promoted to roadmaster, with headquarters at Strasbourg, Sask., to replace **F. Ades,** who has been granted a leave of absence.

R. Johnston, roadmaster on the Canadian National, with headquarters at Prince Albert, Sask., has been transferred to North Battleford, Sask., to succeed **J. R. McLean,** who remains at North Battleford as roadmaster in place of **S. K. Kimball.** Mr. Kimball has been transferred to Melfort, Sask., where he succeeds **W. K. McNaughton,** who has been transferred to Prince Albert to succeed Mr. Johnston.

W. E. Palmer, a track foreman on the Chicago, Milwaukee, St. Paul & Pacific, has been appointed acting roadmaster on the Madison division, with headquarters at Madison, Wis., succeeding **J. T. Loftus,** who has been transferred to the LaCrosse division, with headquarters at La Crosse, Wis., succeeding **T. McMahon. C. A. Drawheim,** roadmaster in charge of an extra gang, has been appointed roadmaster at Janesville, succeeding **H. Zimmerman,** acting roadmaster.

Vernon A. Scobie, whose appointment as supervisor of track on the Pere Marquette, with headquarters at Saginaw, Mich., was noted in the November issue, was born on December 20, 1898, at Standish, Mich. He entered railway service on December 2, 1919, with the Pere Marquette, serving for a number of years as track foreman until his recent appointment as supervisor of track. Mr. Scobie's service with the Pere Marquette has been continuous with the exception of a period of 2¼ years during the World War, when he served overseas with the First United States Division.

Douglas A. Thomson, roadmaster on the Northern Pacific, with headquarters at Spokane, Wash., has been transferred to Lester, Wash., to succeed **Robert E. Mattson,** whose promotion to superintendent of operation of the Northern Pacific Transport Company in Montana, is noted elsewhere in these columns. **Robert A. Sharood,** roadmaster, with headquarters at Fargo, N. D., has been transferred to Spokane, to succeed Mr. Thomson. **J. A. Bryan,** roadmaster, with headquarters at Spokane, has been promoted to division roadmaster of the Idaho division, with the same headquarters, to succeed C. W. Coil. Mr. Coil has been appointed trainmaster-roadmaster, with headquarters at East Grand Forks, Minn., to replace **R. G. Knight,** who has been transferred to Mandan, N. D., to succeed **H. J. McCall,** whose promotion to assistant superintendent in charge of maintenance is noted elsewhere in these columns.

Changes on the Pennsylvania

Edward E. Kinzel, assistant supervisor on the Philadelphia division of the Pennsylvania with headquarters at Downingtown, Pa., has been promoted to supervisor with headquarters at Sharon, Pa. **T. B. Fulkerson,** assistant track

supervisor on the Pittsburgh division of the Pennsylvania, has been promoted to track supervisor on the Cincinnati division, with headquarters at Anderson, Ind., to succeed **A. J. Greenough,** who has been transferred to Harrisburg, Pa. **F. E. Flynn,** supervisor on the Philadelphia division, has been transferred to Wheeling, W. Va., and **A. M. Harris,** assistant supervisor on the Maryland division, has been transferred to the Philadelphia division, with headquarters at Downingtown, Pa., to succeed Mr. Kinzel. **L. W. Green,** acting assistant supervisor, has been appointed assistant supervisor with headquarters at Wilmington, Del., and **E. P. Adams,** acting assistant supervisor on the Baltimore division, has been appointed assistant supervisor on the Philadelphia division, with headquarters at Harrisburg, Pa. **M. C. Fox,** assistant supervisor on the Pennsylvania, with headquarters at Perryville, Md., has been promoted to supervisor, with headquarters at Kittanning, Pa., to succeed **F. H. Pflaging,** who has been transferred to the Philadelphia division, with headquarters at Middletown, Pa. Mr. Pflaging will succeed **J. S. Snyder,** who has been transferred to Derry, Pa., to succeed **J. E. Vandling,** whose promotion to division engineer is noted elsewhere in these columns. **G. C. Vaughn,** assistant supervisor, with headquarters at Washington, D. C., has been transferred to the Middle division, with headquarters at Newport, Pa., to succeed **A. W. Miller,** who has been transferred to the Maryland division, with headquarters at Perryville, to succeed Mr. Fox. **A. H. Hicks** has been appointed assistant supervisor on the Philadelphia division, with headquarters at Harrisburg. **H. W. Swartz,** assistant supervisor on the Baltimore division, has been appointed acting supervisor on the Baltimore division, with headquarters at Baltimore, Md., to succeed **L. E. Gingerich,** whose promotion to assistant division engineer is noted elsewhere in these columns under Engineering.

Mr. Kinzel was born on July 9, 1904, at LaFayette, Ind., and was graduated from Purdue University in 1928. He entered railway service on November 5 of that year as assistant on the engineering corps on the Indianapolis division of the Pennsylvania, and, subsequently, was transferred to Lancaster, Pa., and to Wilmington, Del. In September, 1933, he was promoted to assistant supervisor, with headquarters at Downingtown, Pa., which position he was holding at the time of his recent promotion.

Mr. Fulkerson was born on April 20, 1906, at Bristol, Va., and was educated at the Virginia Military Institute. He entered railway service with the Pennsylvania on July 1, 1928, as an assistant on the engineering corps, serving in this position on various divisions until February, 1932, when he was promoted to assistant supervisor on the Buffalo division, with headquarters at Oil City, Pa. Subsequently he was transferred successively to Olean, N. Y., Homestead, Pa., and Cresson, Pa., being located at the latter point at the time of his recent appointment.

Association News

Maintenance of Way Club of Chicago

Forty-five members and guests attended the meeting on Wednesday evening, November 21, when J. R. Mooney, assistant manager, rail and fastenings department, Robert W. Hunt Company, presented a paper on Current Developments for Improving the Quality of Rail. Presentation of this paper was followed with an informal talk by Prof. H. F. Moore, of the University of Illinois, on the Joint Rail Investigation.

International Railway Maintenance Club

At the last meeting of the International Railway Maintenance Club, which was held on November 8 at the Hotel Statler, Buffalo, N. Y., the following officers were elected for the ensuing year: President, W. H. Newman, signal supervisor, New York Central; vice-president, E. C. Neville, bridge and building master, Canadian National; and secretary, M. B. Morrison, Morrison Railway Supply Corporation (re-elected). The subject under discussion at the meeting, Rail and Flange Lubrication, was introduced by a paper presented by D. M. Clarke, service engineer, The Maintenance Equipment Company. The next meeting of the club will be held on February 14, at the Hotel Statler, Buffalo.

Metropolitan Track Supervisors' Club

The next meeting of the Metropolitan Track Supervisors' Club will be held on Thursday, December 13, at the Hotel McAlpin, New York City, immediately following luncheon, which will be served at 12 o'clock noon. The noon meeting has been arranged to permit the attendance of out-of-town railway men, who may attend the annual dinner of the New York Railway Club on the evening of the same day. The speaker will be H. S. Clarke, engineer maintenance of way of the Delaware & Hudson, who will discuss recent developments in railway track construction and maintenance.

The last meeting of the club was held on October 26, at which time a paper on "Rail Defects" was presented by J. A. Drain, Jr., of the Sperry Rail Service Company.

American Railway Engineering Association

As a result of the letter ballot mailed to the members on October 15, the proposal of the Committee on Track for the adoption as standard of four designs of tie plates was rejected. These designs provided two sizes of plates for the 112-lb. RE rail and two for the 131-lb. RE rail. The larger design for each weight of rail provided a flat bottom and holes for screw hold-down spikes, while the smaller plate for each weight of rail provided two transverse ribs on the bottom and holes for cut hold-down spikes.

The reports of the various standing committees are now rapidly taking final form, and eight reports are already in the hands of the secretary for publication. Several reports will be mailed to the members in bulletin form during the first week of December, and a second bulletin will follow soon.

For the purpose of disposing of unfinished work on their reports, seven committees held meetings in November. The committee on Economics of Railway Labor will meet at Chicago on December 3, while the Track committee will meet in that city on December 11. The meetings during November were as follows: Waterway and Harbors, at Chicago on November 2; Ties, at Chicago on November 13; Masonry, at Chicago on November 15-16; Buildings, at Savannah, Ga., on November 15-16; Waterproofing, at Chicago on November 16; Maintenance of Way Work Equipment, at Chicago on November 20; and Economics of Railway Operation, which met at New York on November 22-23.

Roadmasters Association

Members of the executive committee met at Chicago on November 3 to organize the activities for the new year. Chairmen were selected to direct the investigation of the subjects chosen at the September convention and arrangements were made to bring these subjects to the attention of the members and afford them opportunity to volunteer for service on those committees in which they are most interested.

Arrangements were made to issue news letters to the members at frequent intervals. It was also decided that, effective January 1, dues for membership shall be restored to $4 per year, these dues having been waived during the three preceding years of reduced activity of the organization. A committee was appointed to arrange for hotel facilities for the next convention at Chicago, consisting of Armstrong Chinn, J. J. Davis, D. J. Higgins and Elmer T. Howson.

The Wood-Preservers' Association

The thirty-first annual convention will be held at the Hotel Pennsylvania, New York, on January 22-24, 1935. As heretofore, a special feature of the meeting will be the users' day session on Wednesday forenoon, January 23, at which session H. R. Clarke, engineer maintenance of way of the C. B. & Q., will present a paper on The Experience of the Chicago, Burlington & Quincy With the Treatment of Cross-ties, and George W. Rear, bridge engineer of the S. P. Company, will present a paper on the Southern Pacific's Experience With Treated Timber in Bridge Construction. R. M. Wirka of the U. S. Forest Products Laboratory will also present a report at this session on the University Avenue Test Track of the C. M. St. P. & P. Committees will present service records of crossties, marine piling and poles, and will also report on the pressure and non-pressure treatment of poles and the diversified uses of treated wood. Other committees will report on the more technical activities of the association.

Woodings Forge & Tool Co.

The DOTSERO CUT-OFF of the DENVER and RIO GRANDE WESTERN RAILROAD recently completed reduces the distance between Denver and Salt Lake City by 175 miles.

The track of this modern piece of railroad construction which passes through some of the most rugged and scenically beautiful country in the world is equipped throughout with WOODINGS rail anchors.

New track on the Dotsero Cut-off at the entrance to Red Canyon. Denver and Rio Grande Western Railroad.

Woodings Forge & Tool Co.

VERONA, PA.

Arrangements are being made for Western members to travel to the convention in a party, leaving Chicago at 5:30 Sunday evening, January 21, via the New York Central, with connecting cars from Cincinnati and Cleveland, stopping enroute to visit the timber treating plant of the American Creosoting Company at Rome, N. Y., on Monday morning.

The Nominating committee has presented the following as candidates for office for the year beginning with the adjournment of the convention: For president, F. D. Mattos, manager treating plants, S. P. Co., West Oakland, Cal.; first vice-president, R. S. Manley, president, Texas Creosoting Co., Orange, Tex.; second vice-president, F. C. Shepherd, consulting engineer, B. & M., Boston, Mass.; treasurer, H. L. Dawson; executive committee, B. M. Winegar, Canada Creosoting Co., Montreal, Que., and W. R. Goodwin, engineer wood preservation, M. St. P. & S.S.M., Minneapolis, Minn.

Supply Trade News

General

The American Rolling Mill Company, Middletown, Ohio, has established a new sales office in the Citizens and Southern National Bank building, Atlanta, Ga. **C. M. Broome, Jr.,** is assistant district manager in charge of this office. The new Armco sales office will serve the states of Florida, South Carolina, Alabama, Georgia and parts of Tennessee and North Carolina, which territory was formerly covered by the Middletown district office.

Preferred stockholders of the **McKinney Steel Holding Company** voted approval of the merger of the **Corrigan, McKinney Steel Company** with the **Republic Steel Corporation,** on October 25. Provisions under which the preferred stock of the holding company was issued were to the effect that two-thirds of this class of stockholders must approve any merger. At the meeting on October 25, 57,105 shares, or 78.7 per cent, were voted for the merger and 461 against. There are 72,500 preferred shares outstanding, of which the Union Trust Company owns more than a third. The special meeting of stockholders of the Republic Steel Corporation to vote on the Republic and Corrigan, McKinney Steel Company merger has been postponed to December 17.

Personal

J. F. Cruikshank has become associated with **Fairbanks, Morse & Company,** Chicago, as special representative in both the general scale and the general railroad sales divisions.

Robert J. Working, assistant district sales manager of the **Republic Steel Corporation,** with headquarters at Cincinnati, Ohio, has been promoted to district sales manager, with the same headquarters, to succeed **W. A. Peck.**

Russell E. Colgate, chairman of the board of the **Tyson Roller Bearing Corporation,** Massillon, Ohio, has been elected president and treasurer, succeeding **Charles E. Stuart,** who has resigned. Mr. Stuart will remain as a member of the board of directors.

Roscoe Seybold, controller of the **Westinghouse Electric & Manufacturing Company, William G. Marshall,** assistant to vice-president and **Ralph Kelly,** director of the budget, have been elected vice-presidents, all with headquarters at East Pittsburgh, Pa. **F. R. Kohnstamm,** sales promotion manager at Pittsburgh, has been appointed manager of the Lighting division, with headquarters at Cleveland, Ohio.

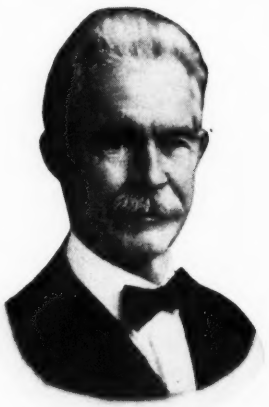
Whitley B. Moore has been appointed general manager of the Industrial division of the **Timken Roller Bearing Company,** Canton, Ohio. Mr. Moore was graduated from the University of Michigan in 1918, going immediately into service in the U. S. Navy. At the close of the war, he joined the engineering staff of The Timken Roller Bearing Company. In 1921, Mr. Moore was transferred to the Pacific coast in charge of sales in that territory. In 1924 he returned to Canton to serve as assistant general sales manager of the Industrial division and since 1930 was sales manager.

Frederic Crosby, vice-president in charge of production of the **American Hoist & Derrick Company,** St. Paul, Minn., who has been elected president of this company, as noted in the November

Frederic Crosby

issue, was born in St. Paul in 1887 and attended the University of Minnesota. He spent his apprenticeship in the plant of the company, working up through various departments until 1922, when he was appointed general manager in charge of production. He held this position until 1928, when he was elected vice-president in charge of production, which position he has held until his recent election.

Frank J. Johnson, whose resignation, because of ill health, as president of the **American Hoist & Derrick Company,** St. Paul, Minn., was noted in the November issue, was born in 1856 at Racine, Wis. In 1881, in partnership with Oliver Crosby, he opened a machine shop, founding the American Manufacturing Company in 1882. In 1892, this company was reorganized as the American Hoist & Derrick Company, and the manufacturing facilities were enlarged. In the same



Frank J. Johnson

year Mr. Johnson went to Chicago to establish a sales office, remaining there until December, 1922, when he returned to the St. Paul office.

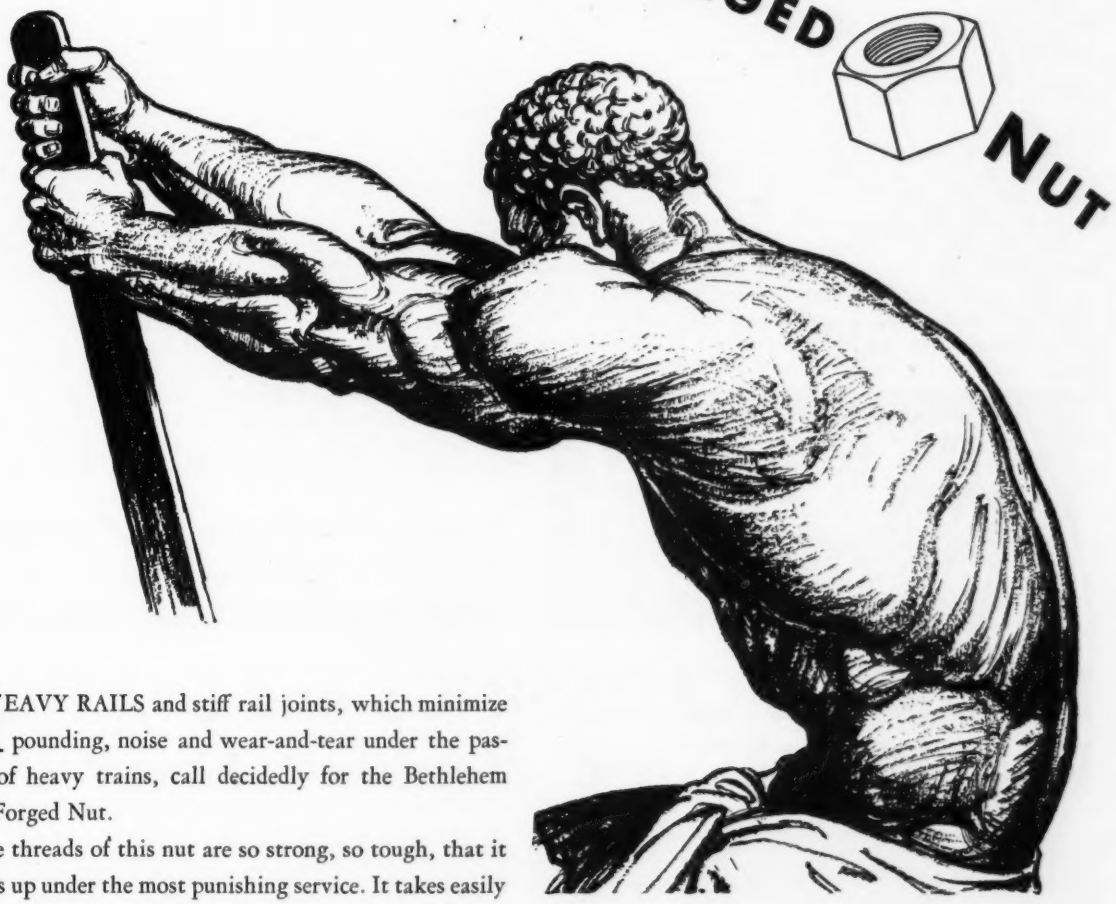
L. M. Klinedinst, vice-president in charge of all industrial sales of the **Timken Roller Bearing Company,** Canton, Ohio, was elected to the board and also promoted to the office of vice-president in charge of sales, to fill the vacancy created by the recent resignation of **Judd W. Spray,** at a meeting of the board of directors on October 30. **T. V. Buckwalter,** who has been vice-president of the Timken Roller Bearing Company for several years, has been elected vice-president and director of the **Timken Steel & Tube Company.** Mr. Klinedinst has been associated with the Timken Company since leaving school 29 years ago; after serving in various junior executive positions in both the manufacturing and selling divisions he was identified with automotive development work for many years, serving as assistant sales manager. In 1921 he was appointed general manager of the Industrial division, and since 1930 has been vice-president in charge of all industrial sales.

Trade Publications

"Thumbs Down on Rust"—This is the title of a leaflet recently issued by the Republic Steel Corporation, Massillon, Ohio, in which are described and explained the rust-resisting properties of Toncan iron. Photographs, accompanied by descriptive paragraphs, demonstrate the various uses to which Toncan iron has been applied.

Industrial Cable—The General Electric Company, Schenectady, N. Y., has issued an illustrated booklet, containing 128 pages, in which are described and listed all the standard types of insulated wire and cable that are used in industries for transmission, distribution and control, as well as for use on or with electric equipment, such as arc welders, etc.

Why railroads need this HOT-FORGED NUT



HEAVY RAILS and stiff rail joints, which minimize pounding, noise and wear-and-tear under the passage of heavy trains, call decidedly for the Bethlehem Hot-Forged Nut.

The threads of this nut are so strong, so tough, that it stands up under the most punishing service. It takes easily heavy wrenching stresses and sharp, sudden lateral thrusts from the springing of a heavy joint under load. Used with heat-treated track bolts, Bethlehem Hot-Forged Nuts form a fastening of matched quality.

Use Bethlehem Hot-Forged Nuts in cars and engines, in switches and frogs, as well as in rail joints—in fact, wherever conditions call for an extra-strong nut with tough threads. These nuts are forgings, with the added strength and toughness that forging gives. They don't split, nor round out, nor "mushroom." They're the logical nuts to use for every heavy-duty job.

Bethlehem Hot-Forged Nuts are made at our Lebanon, Pa., Plant, where Bethlehem Track Bolts, noted for their uniform, high strength, are also made. In addition, Lebanon Plant makes related products for every railway requirement. Frog bolts, engine bolts, staybolts and superheater bolts. Corrosion-resisting bolts. Track spikes, made from new-billet steel. Rivets. Turnbuckles. And many special items.

For service to you, Bethlehem carries at Lebanon an extensive range of standard commercial items ready for immediate shipment.

BETHLEHEM BOLTS AND NUTS

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New Method Slashes Bridge Maintenance Costs

Dearborn recommends adoption of the following method to sharply reduce bridge maintenance costs:

Surface to be brushed or sprayed with a coat of NO-OX-ID "A Special". No thorough cleaning of surface necessary. Heavy loose rust scale should be removed. The action of NO-OX-ID is to penetrate through existing corrosion and arrest it. This penetrating action results in the scale being loosened but while this action is progressing, complete protection is afforded by the NO-OX-ID. After all old rust is killed, if desired, a prime coat of NO-OX-ID Gloss Filler Red or Gloss Filler Black may be applied—over this your standard bridge paint.

With NO-OX-ID employed according to this method, the expensive hand work of scraping off hard, close clinging rust scale and old paint is eliminated. NO-OX-ID penetrates, softens and loosens it and stops corrosion with definite fundamental chemical reactions. NO-OX-ID contains chemical rust inhibitors and permanently stops all sub-surface corrosion. Never again will it be necessary to spend large sums to clean surfaces prior to recoating. Here is a method that has been thoroughly proven and is in practice on many railroads. Dearborn recommends it in your 1935 program as a means of sharply reducing maintenance costs. This method can be used with equal effectiveness in other maintenance work. Inquiries invited.

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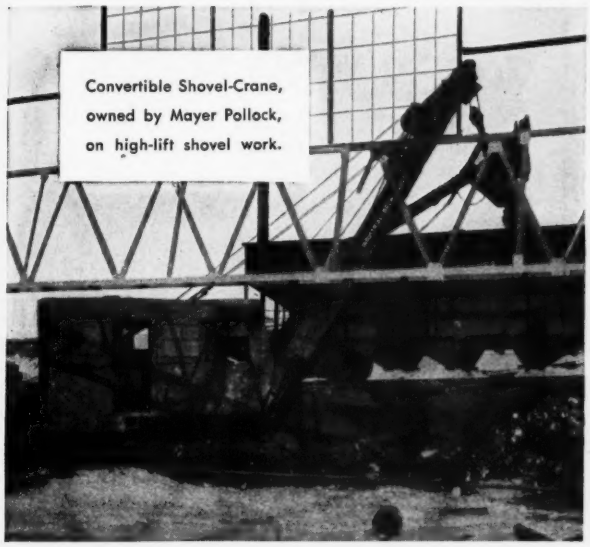

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"FIRST CLASS... in every way"

Mayer Pollock of Pottstown, Pa., bought their first Industrial Brownhoist 25 years ago. Economies effected by it led to additional purchases and today they own six! Why? Let them tell you in their own words. "We find that your cranes are first class in workmanship in every way, giving us little trouble and expense, and they are economical in operation and upkeep."

This user's experience and opinion of Industrial Brownhoists is typical. Positive proof of this is that far more Industrial Brownhoist cranes have been purchased than any other make.

If you are skeptical as to whether a good locomotive or crawler crane will more than just pay out for you, let an Industrial Brownhoist sales engineer tell you what these cranes will do. Make him prove his case. Then, having the facts, you be the judge.

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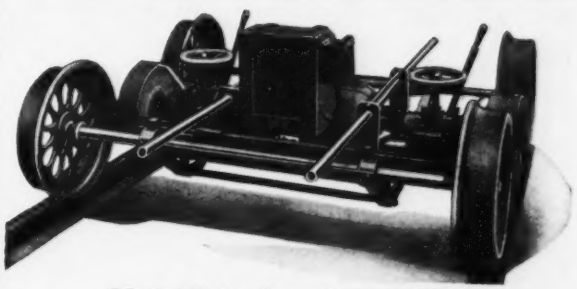

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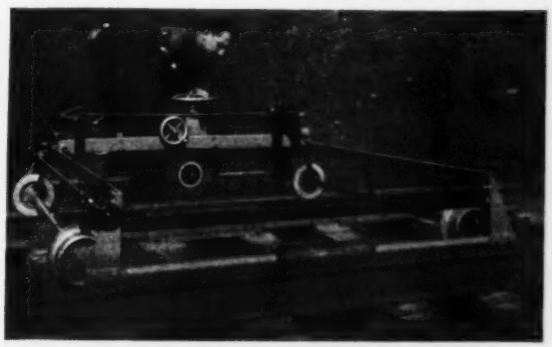

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You can get Timken advantages in all the leading makes of section cars, for car manufacturers know that there is no substitute for the exclusive combination of Timken tapered construction, Timken positively aligned rolls and Timken Alloy Steel. New section cars, Timken-equipped, will pay for themselves in a short time with the savings they will effect.

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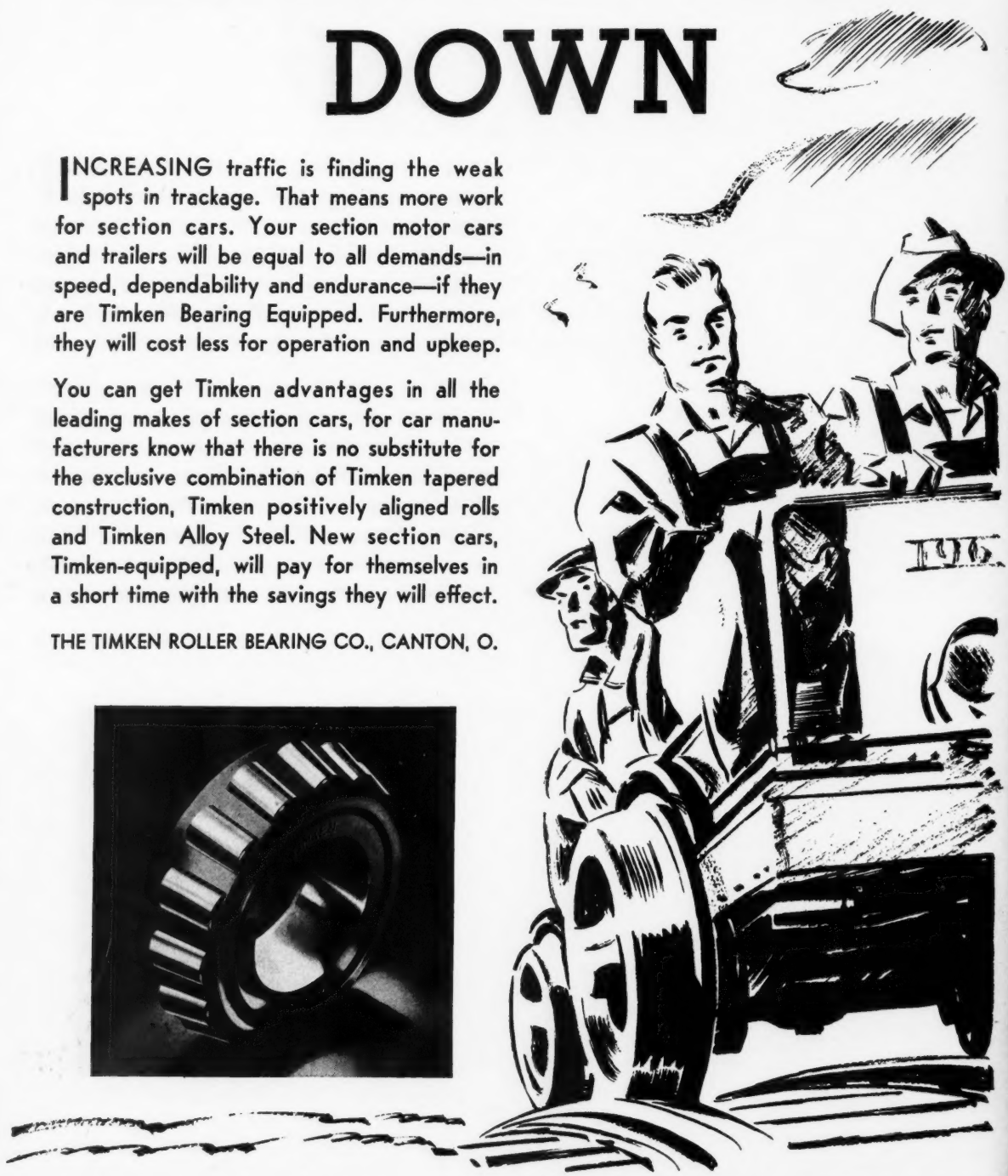

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